United States Government Accountability Office

GAO

Report to Congressional Committees

March 2010

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

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GAO-10-388SP

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **MAR 2010**	2. REPORT TYPE	3. DATES COVERED **00-00-2010 to 00-00-2010**
4. TITLE AND SUBTITLE **Defense Acquisitions: Assessments of Selected Weapon Programs**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Government Accountability Office,441 G Street NW,Washington,DC,20548**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR’S ACRONYM(S) 11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**182**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

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Highlights

Highlights of GAO-10-388SP, a report to congressional committees

March 2010

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

Why GAO Did This Study

This is GAO's eighth annual assessment of selected Department of Defense (DOD) weapon programs. The report examines how well DOD is planning and executing its weapon acquisition programs, an area that has been on GAO's high-risk list since 1990.

This year's report is in response to the mandate in the joint explanatory statement to the DOD Appropriations Act, 2009. The report includes (1) observations on DOD's efforts to manage its portfolio of major defense acquisition programs; (2) an assessment of the knowledge attained by key junctures in the acquisition process for a subset of 42 weapon programs from the 2009 portfolio; (3) data on other factors that can affect program execution; and (4) examples of how DOD is implementing recent acquisition reforms. To conduct the assessment, GAO analyzed data on the composition of DOD's portfolio of major defense acquisition programs. GAO did not analyze the cost and schedule performance of the portfolio because DOD did not issue timely or complete Selected Acquisition Reports for the second consecutive presidential transition. GAO expects to resume its portfolio analysis in next year's assessment. GAO also collected data from program offices on technology, design, and manufacturing knowledge, as well as on other factors that can affect program execution. GAO analyzed this data and compiled one- or two-page assessments of 70 weapon programs.

View GAO-10-388SP or key components.
For more information, contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

What GAO Found

In 2009, the Secretary of Defense proposed canceling or significantly curtailing weapon programs with a projected cost of at least $126 billion. Congress supported several of the recommended terminations. DOD plans to develop new options to replace several of the canceled programs. The most significant of these will be the effort to restructure the Army's terminated Future Combat System program. At the same time, DOD's 2009 portfolio of major defense acquisition programs grew to 102 programs—a net increase of 6 since last year. DOD did not issue complete Selected Acquisition Reports for these programs in 2009, which precluded an analysis of the overall cost and schedule performance of DOD's portfolio in this year's assessment.

Secretary of Defense's Fiscal Year 2010 Budget Recommendations

	Weapon system	Secretary's comments
Recommended termination	VH-71 Presidential Helicopter	Plan to develop options for a new program
	Combat Search and Rescue Helicopter	Plan to reexamine requirements
	Next-Generation Bomber	Will not initiate new development program without better understanding of the requirement and technology
	Future Combat Systems–Manned Ground Vehicles	Plan to reevaluate requirements, technology, and approach before relaunching and recompeting program
	Transformational Satellite	Plan to buy two more AEHF satellites as alternative
	Ballistic Missile Defense–Multiple Kill Vehicle	Plan to reexamine requirements; no mention of new program
Recommended end of production	C-17	Recommended ending production at 205 aircraft
	DDG-1000	Recommended ending production at 3 ships
	F-22	Recommended ending production at 187 aircraft

Source: GAO analysis of DOD data.

For 42 programs GAO assessed in depth, there has been continued improvement in the technology, design, and manufacturing knowledge programs had at key points in the acquisition process. However, most programs are still proceeding with less knowledge than best practices suggest, putting them at higher risk for cost growth and schedule delays. A majority of programs have also experienced requirements changes, software development challenges, or workforce issues, or a combination, which can affect program stability and execution. DOD has begun to implement a revised acquisition policy that addresses many of these areas. For example, seven programs we examined in technology development plan to test competitive prototypes before starting system development, and nine programs plan to hold early systems engineering reviews. If DOD consistently applies this policy, the number of programs adhering to a knowledge-based acquisition should increase and the outcomes for DOD programs should improve.

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Related GAO Products

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Abbreviations

B-2 EHF SATCOM	B-2 Spirit Advanced Extremely High Frequency SATCOM
BMDS	Ballistic Missile Defense System
CDR	critical design review
DOD	Department of Defense
FCS	Future Combat System
FY	fiscal year
GPS	Global Positioning Systems
LRIP	low-rate initial production
MDA	Missile Defense Agency
MDAP	major defense acquisition program
MRAP	Mine Resistant Ambush Protected Vehicle
NA	not applicable
PDR	preliminary design review
RDT&E	research, development, test and evaluation
SAR	Selected Acquisition Report
TRL	Technology Readiness Level

United States Government Accountability Office
Washington, D.C. 20548

March 30, 2010

Congressional Committees

I am pleased to present GAO's eighth annual assessment of selected weapon programs. The report provides a snapshot of how well the Department of Defense (DOD) is planning and executing its major defense acquisition programs—an area that has been on GAO's high-risk list since its inception in 1990. The past 15 months have seen DOD and Congress take meaningful steps towards addressing long-standing weapon acquisition issues. Many of these actions are consistent with our past recommendations. DOD made major revisions to its acquisition policies to place more emphasis on acquiring knowledge about requirements, technology, and design before programs start—thus putting it in a better position to field capabilities on time and at the estimated cost. Congress strengthened DOD's acquisition policies and processes by passing the Weapon System Acquisition Reform Act of 2009, which includes provisions to ensure programs are based on realistic cost estimates and to terminate programs that experience high levels of cost growth. The Secretary of Defense proposed a fiscal year 2010 budget that ended or curtailed all or part of at least a half dozen major defense acquisition programs—such as the Air Force's F-22A Raptor, the Army's Future Combat System, the Navy's DDG 1000 destroyer, and the Missile Defense Agency's Multiple Kill Vehicle—that were over cost, behind schedule, or no longer suited to meet the warfighters' current needs. Congress's support for several of the recommended terminations signaled a willingness to make difficult choices on individual weapon systems and DOD's major defense acquisition program portfolio as a whole.

While DOD's acquisition policies and process may be improving, fiscal pressures continue to build. Notwithstanding the federal government's long-term fiscal challenges, the Pentagon faces its own near-term and long-term fiscal pressures as it attempts to balance competing demands, including ongoing operations in Afghanistan and Iraq, initiatives to grow and modernize the force, and increasing personnel and health care costs. While DOD's fiscal year 2010 budget request started the process of reprioritizing acquisition dollars to meet warfighters' most pressing needs, the department must still address the overall affordability of its weapon system investments. Our report this year indicates the number of major defense acquisition programs has grown in the past year from 96 to 102, although DOD's efforts to reprioritize its acquisition investments are still ongoing. DOD should continue to work to balance its weapon system

portfolio with available funding, which includes reducing the number or size of weapon system programs, or both, and assessing the affordability of new programs and capabilities in the context of overall defense spending.

We believe that this report can provide insights that will help DOD place programs in a better position to succeed, and help the department maximize its investments. One of the surest ways that DOD can ensure it delivers the promised return on investment for its weapon system spending is to execute programs using a knowledge-based acquisition approach. Our review this year found continued improvement in the knowledge DOD officials had about programs' technologies, designs, and manufacturing processes at key points in the acquisition process. However, most programs are still proceeding with less knowledge than best practices suggest, putting them at higher risk for cost growth and schedule delays. If DOD consistently applies its revised acquisition policy, we expect to see the number of programs adhering to a knowledge-based acquisition increase, and at the same time, the outcomes for those programs improve. These policies must also be reinforced by DOD and Congress in their decisions on whether or not to fund individual programs.

Our report this year does not include an analysis of the performance of DOD's major defense acquisition program portfolio. In recent years, this analysis showed that the cumulative cost growth on DOD programs had reached $300 billion (in fiscal year 2010 dollars). DOD did not issue timely or complete Selected Acquisition Reports for its major defense acquisition programs in fiscal year 2009 for the second consecutive presidential transition, which precluded an analysis of the overall cost and schedule performance of DOD's portfolio. GAO expects to resume its portfolio analysis in next year's assessment.

Gene L. Dodaro
Acting Comptroller General
of the United States

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United States Government Accountability Office
Washington, D.C. 20548

March 30, 2010

Congressional Committees

This is GAO's eighth annual assessment of selected Department of Defense (DOD) weapon programs and the second in response to the mandate in the joint explanatory statement to the DOD Appropriations Act, 2009.[1] This report provides a snapshot of how well DOD is planning and executing its weapon programs—an area that has been on GAO's high-risk list since 1990. Since last year's report, the executive and legislative branches have taken actions that altered the direction of individual major defense acquisition programs, as well as the way DOD must manage these acquisitions. In DOD's fiscal year 2010 budget request, the Secretary of Defense proposed ending all or part of at least a half dozen major defense acquisition programs that were over cost, behind schedule, or no longer suited to meet the warfighters' current needs. Congress enacted the Weapon System Acquisition Reform Act of 2009,[2] which built on previous congressional actions, our past recommendations, and DOD policy changes designed to put weapon programs on solid footing before they begin and maintain discipline throughout the acquisition process.

This report includes (1) observations on DOD's efforts to manage its portfolio of major defense acquisition programs, (2) our assessment of the knowledge attained by key junctures in the acquisition process for a subset of 42 weapon programs—primarily in development or the early stages of production—from the 2009 portfolio, (3) data on other factors that can affect program execution, and (4) examples of how DOD is implementing its revised acquisition policy for major defense acquisition program.

To conduct our assessment of DOD's management of its major defense acquisition program portfolio, we collected and analyzed data on the

[1]See Explanatory Statement, 154 Cong. Rec. H 9427, 9526 (daily ed. Sept. 24, 2008), to the Department of Defense Appropriations Act Fiscal Year 2009, contained in Division C of the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009, Pub. L. No. 110-329.

[2]Pub. L. No. 111-23.

composition of DOD's portfolio in 2009.[3] Our ability to analyze the cost and schedule performance of the 2009 portfolio was limited this year because DOD did not prepare Selected Acquisition Reports that reflected the Secretary of Defense's proposed changes to weapon programs in the fiscal year 2010 budget. Instead, we made observations on programs entering and exiting DOD's portfolio of major defense acquisition programs using DOD budget documentation, fiscal year 2010 authorization and appropriation acts, December 2007 Selected Acquisition Reports, DOD's list of major defense acquisition programs, and other program data.

To conduct our assessments of individual programs, we obtained information on the extent to which they followed knowledge-based practices for technology maturity, design stability, and production maturity, from a data collection instrument provided to each program office. We also collected information from program offices on other aspects of program management including systems engineering, requirements changes, software development, and program office staffing. Overall, we collected information on 70 weapon programs. We chose these programs based on their estimated cost, stage in the acquisition process, and congressional interest. Our assessment of how well programs are adhering to a knowledge-based acquisition approach includes a subset of 42 major defense acquisition programs from DOD's 2009 portfolio.[4]

We conducted this performance audit from August 2009 to March 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings based on our audit

[3]Major defense acquisition programs are those identified by DOD that require eventual total research, development, test and evaluation (RDT&E) expenditures, including all planned increments, of more than $365 million or procurement expenditures, including all planned increments, of more than $2.19 billion in fiscal year 2000 constant dollars.

[4]The 28 programs in our assessment that are not covered in this analysis include: 10 pre–major defense acquisition programs, 6 Missile Defense Agency elements, 5 Navy shipbuilding programs, 3 components or subprograms within major defense acquisition programs, 2 programs that are been terminated or are ending, 1 major defense acquisition program that is based on a commercially-derived aircraft, and 1 acquisition category II program. An acquisition category II program is defined as a program that does not meet the criteria for an acquisition category I program and is estimated to require eventual total RDT&E expenditures of more than $140 million or procurement expenditures of more than $660 million in fiscal year 2000 constant dollars.

objectives. Appendix I contains detailed information on our scope and methodology.

Observations on DOD's 2009 Major Defense Acquisition Program Portfolio

We make four overall observations or points concerning DOD's management of its major defense acquisition portfolio this year. First, in DOD's fiscal year 2010 budget, the Secretary of Defense proposed canceling or significantly curtailing programs with projected total costs of at least $126 billion that he characterized as too costly or no longer relevant for current operations, while increasing funding for others that he assessed as higher priorities. Second, DOD plans to replace several of the canceled programs in fiscal years 2010 and 2011, hopefully with new, knowledge-based acquisition strategies, because the warfighter need remains. The most significant of these new programs will be the effort to restructure the Army's terminated Future Combat System program into several smaller, integrated programs. Third, DOD's portfolio of major defense acquisition programs grew to 102 programs in 2009—a net increase of 6 since December 2007. Eighteen programs with an estimated cost of over $72 billion entered the portfolio,[5] while 12 programs with an estimated cost of $48 billion, including over $7 billion in cost growth, left the portfolio.[6] When the Future Combat System is added to the programs leaving the portfolio, the total cost of these programs increases to $179 billion, including over $47 billion in cost growth. Finally, our analysis of this year's portfolio was limited by the lack of timely Selected Acquisition Reports that reflected the Secretary of Defense's proposed changes to the programs in the portfolio.

Additional details about each of these four observations follow:

- **The Secretary of Defense's fiscal year 2010 budget recommended the cancellation of several high-risk acquisition programs.** In April 2009, the Secretary of Defense recommended canceling or curtailing all or part of at least a half dozen major defense acquisition programs—including the Air Force's Combat Search and Rescue helicopter, the Army's Future Combat System, the Missile Defense Agency's Multiple Kill Vehicle, and the Navy's VH-71 Presidential

[5]Cost data were only available for 13 of the 18 newly designated major defense acquisition programs.

[6]The estimated cost for these 12 programs is based on DOD's December 2007 Selected Acquisition Reports. Cost growth was calculated from the programs' first cost estimate.

Helicopter Replacement—that were over cost, behind schedule, no longer suited to meet the warfighters' current needs, or based on a single service, instead of a joint solution. In announcing these changes, the Secretary estimated that the total cost of three of the programs recommended for cancellation exceeded $126 billion.[7] Table 1 provides a summary of some of the Secretary of Defense's recommendations in DOD's fiscal year 2010 budget request.

Table 1: Secretary of Defense's Fiscal Year 2010 Budget Recommendations

	System	Total estimated cost (dollars in billions)	Secretary's comments	Congressional action
Recommended termination	VH-71 Presidential Helicopter	$13	Plan to develop options for a new program	Conferees recommended $100 million for technology capture that DOD has budgeted for the VH-71 program.
	Combat Search and Rescue Helicopter	Unspecified	Plan to reexamine requirements	Did not authorize appropriations for the program.
	Next-Generation Bomber	Unspecified	Will not initiate new development program without better understanding of the requirement and technology	Supported development of a Next-Generation Bomber Aircraft, but did not authorize appropriations.
	Future Combat System–Manned Ground Vehicles	87	Plan to reevaluate requirements, technology, and approach before relaunching and recompeting program	Directed Army to develop, test, and field an operationally effective and affordable next-generation ground combat vehicle. Conferees recommended rescission of $26 million in existing funding.
	Transformational Satellite	26	Plan to buy two more AEHF satellites as alternative	Did not authorize appropriations for the program.
	Ballistic Missile Defense–Multiple Kill Vehicle	Unspecified	Plan to reexamine requirements; no mention of new program	Did not authorize appropriations for the program.

[7]Data used to compute value of deletions and curtailments are based entirely on information provided by the Secretary of Defense when announcing budgetary recommendations. As shown in table 1, DOD did not specify a value to those programs that plan to end production.

(Continued From Previous Page)

	System	Total estimated cost (dollars in billions)	Secretary's comments	Congressional action
Recommended end of production	C-17	Unspecified	Recommended ending production at 205 aircraft	Conferees recommended $2.5 billion for the procurement of 10 C-17 aircraft, associated spares, support equipment, and training equipment.
	DDG 1000	Unspecified	Recommended ending production at 3 ships	Did not fund additional ships. Appropriated $1.4 billion for completion of third DDG 1000.
	F-22	Unspecified	Recommended ending production at 187 aircraft	Did not fund additional aircraft. Conferees recommended rescission of $383 million in existing funding.
Total		**$126**		

Source: GAO analysis of Secretary's April 2009 statement on fiscal year 2010 budget and fiscal year 2010 DOD authorization and appropriations acts.

- **DOD is currently developing options for new programs to replace the Future Combat System and VH-71 Presidential Helicopter that will begin in fiscal year 2010 or 2011.** While DOD recommended canceling existing programs with high-risk acquisition strategies, such as the manned ground vehicle portion of the Future Combat System and the VH-71 Presidential Helicopter, the capability needs these systems were supposed to fill still exist. In both cases, DOD is currently developing options for new programs that will begin in fiscal year 2010 or 2011. The Army is planning the acquisition strategy to deliver residual capabilities from the Future Combat System program. While its plans are still preliminary, it has already made a decision to produce the first increment of equipment from the Future Combat System program; begin development of follow-on equipment; establish an approach to acquiring future increments of network capabilities; and plan for the development of a new ground combat vehicle. The Navy is currently conducting early systems engineering activities including analyzing requirements and alternative approaches to meeting those requirements to support the start of a new presidential helicopter replacement program. In both cases, DOD has an opportunity to develop lower-risk alternatives with requirements that are aligned with available technology and funding and better reflect warfighters' current needs.

- **DOD's portfolio of major defense acquisition programs continues to grow.** Between December 2007 and July 2009, DOD's portfolio of

major defense acquisition programs grew from 96 to 102 programs.[8] Overall, 18 percent of the portfolio or 18 programs are newly designated major defense acquisition programs. These programs have a total estimated cost of over $72 billion.[9] Cost data were only available for 13 of these programs. Not all of these programs entering the portfolio are new starts. For instance, the Airborne Signals Intelligence Payload, the MQ-9 Reaper Unmanned Aircraft System, the Extended Range Multi-Purpose Unmanned Aircraft System, and the Predator Unmanned Aircraft System programs all began as acquisition category II programs, but their total research and development or procurement costs now exceed the threshold for major defense acquisition programs. Twelve programs with an estimated total cost of $48 billion as of December 2007, including over $7 billion in cost growth, left the portfolio.[10] These programs left the portfolio for a variety of reasons, including program restructure, termination, or completion. Due to the methodology we used to identify the programs entering and exiting the portfolio, our analysis did not include the Future Combat System program, which is being significantly restructured as part of the Secretary of Defense's fiscal year 2010 budget recommendations. As of December 2007, the estimated total acquisition cost of the Future Combat System program was over $131 billion (fiscal year 2010 dollars), which includes over $40 billion in cost growth (fiscal year 2010 dollars) since the start of development. At the time of our review, DOD did not have a cost

[8]We compared the number of major defense acquisition programs with Selected Acquisition Reports in December 2007 to the number of programs on DOD's June 2009 major defense acquisition program list.

[9]The programs that entered the portfolio between December 2007 and July 2009 include: Broad Area Maritime Surveillance Unmanned Aerial System, KC-X, Joint Tactical Radio System Airborne, Maritime, Fixed-Station, Joint High Speed Vessel, Global Positioning System IIIA, C-27J, Extended Range/Multipurpose Unmanned Aircraft System, Reaper Unmanned Aircraft System, Global Command Support System–Army, Joint Precision Aircraft Landing System, Airborne Signals Intelligence Payload, Navy Large Aircraft Infrared Countermeasures, Airborne Warning and Control System Upgrade, EA-6B, Integrated Defensive Electronic Countermeasures, Joint and Allied Threat Awareness System, Predator Unmanned Aerial System, and WIN-T Increment 3.

[10]The programs that left the portfolio between December 2007 and July 2009 include: Mission Planning System Increments I-III, Armed Reconnaissance Helicopter, CVN 68 Nimitz Class Nuclear Powered Aircraft Carrier, Extended Range Munition, Minuteman III Guidance Replacement Program, Minuteman III Propulsion Replacement Program, VH-71 Presidential Helicopter Replacement, Javelin, SSGN-Ohio Class Submarine Conversion, Advanced Deployable System (AN/WQR-3), Ship Self Defense System Program, and T-45TS GOSHAWK Undergraduate Jet Pilot Training System.

estimate for the new programs that will replace the Future Combat System.

- **The lack of complete Selected Acquisition Report data for 2009 precludes an analysis of the overall cost and schedule performance of DOD's portfolio of major defense acquisition programs.** DOD did not comply with statutory requirements when it did not issue Selected Acquisition Reports within 60 days of its fiscal year 2010 budget submission on May 7, 2009.[11] DOD prepared limited Selected Acquisition Reports for 85 of 102 major defense acquisition programs by November 2009, 6 months after the budget was submitted.[12] The data in the limited Selected Acquisition Reports were not complete. Program costs were not updated from December 2007 Selected Acquisition Reports, except to reflect changes in the funding received in fiscal year 2009 and funding requested in fiscal year 2010. According to DOD, the rest of the cost data on programs could not be updated because the fiscal year 2011–2015 Future Years Defense Program was not complete.

Observations from Our Assessment of Knowledge Attained by Key Junctures in the Acquisition Process

For 42 individual weapon programs in DOD's 2009 portfolio, we assessed the knowledge attained by key junctures in the acquisition process. Our analysis allows us to make five observations about DOD's management of technology, design, and manufacturing risks and its use of testing and early systems engineering to reduce these risks. These observations present a mixed picture of DOD's adherence to a knowledge-based acquisition approach. First, newer programs are beginning with higher levels of technology maturity, but they are not taking other steps, such as holding early systems engineering reviews, to ensure there is a match between

[11]DOD is required to submit Selected Acquisition Reports to Congress at the end of each fiscal year quarter on current major defense acquisition programs, although certain exceptions apply. Selected Acquisition Reports for the first quarter of a fiscal year are known as comprehensive annual Selected Acquisition Reports. Each comprehensive annual Selected Acquisition Report is required to be submitted within 60 days after the date on which the President transmits the Budget to Congress for the following fiscal year. 10 U.S.C. § 2432(b)(1), (c)(4), (f).

[12]Four programs prepared a baseline Selected Acquisition Report or a Selected Acquisition Report following a Nunn-McCurdy unit cost breach; one program was designated a Major Acquisition Information System Program; and twelve programs that were new major defense acquisition programs or were being restructured did not prepare any Selected Acquisition Reports.

requirements and resources. Second, programs that have held critical design reviews in recent years reported higher levels of design knowledge; however, few programs are demonstrating that the design is capable of meeting performance requirements by testing an integrated prototype. Third, some programs are taking steps to bring critical manufacturing processes into control; however, many programs still rely on “after the fact” metrics. Fourth, programs are still not regularly testing production representative prototypes before committing to production. Fifth, more programs are using reliability growth curves before beginning production. While program knowledge is increasing, as in the past, none of the 42 programs we assessed have attained or are on track to attain all of the requisite amounts of technology, design, and production knowledge by each of the key junctures in the acquisition process.[13] However, if DOD consistently implements its December 2008 policy revisions on new and ongoing programs, then DOD’s performance in these areas, as well as its cost and schedule outcomes, should improve.

Good acquisition outcomes require the use of a knowledge-based approach to product development that demonstrates high levels of knowledge before significant commitments are made. Achieving the right knowledge at the right time enables leadership to make informed decisions about when and how best to move into various acquisition phases. In essence, knowledge supplants risk over time. This building of knowledge consists of information that should be gathered at three critical points over the course of a program.

- **Knowledge point 1: Resources and requirements match.** Achieving a high level of technology maturity by the start of system development is an important indicator of whether this match has been made.[14] This means that the technologies needed to meet essential product

[13]Not all programs provided information for every knowledge point or had reached all of the knowledge points—development start, design review, and production start.

[14]The start of system development, as used here, indicates the point at which significant financial commitment is made to design, integrate, and demonstrate that the product will meet the user’s requirements and can be manufactured on time, with high quality, and at a cost that provides an acceptable return on investment. Under the revised Department of Defense Instruction 5000.02, Operation of the Defense Acquisition System (Dec. 8, 2008), system development is now called engineering and manufacturing development. Engineering and manufacturing development follows materiel solution analysis and technology development. For shipbuilding programs, this point occurs when a program awards a detailed design and construction contract.

requirements have been demonstrated to work in their intended environment. In addition, the developer has completed a preliminary design of the product that shows the design is feasible.

- **Knowledge point 2: Product design is stable.** This point occurs when a program determines that a product's design will meet customer requirements, as well as cost, schedule, and reliability targets. A best practice is to achieve design stability at the system-level critical design review, usually held midway through system development. Completion of at least 90 percent of engineering drawings at this point or 100 percent of the 3D product models for ships at fabrication start provides tangible evidence that the product's design is stable, and a prototype demonstration shows that the design is capable of meeting performance requirements.

- **Knowledge point 3: Manufacturing processes are mature.** This point is achieved when it has been demonstrated that the developer can manufacture the product within cost, schedule, and quality targets. A best practice is to ensure that all critical manufacturing processes are in statistical control—that is, they are repeatable, sustainable, and capable of consistently producing parts within the product's quality tolerances and standards—at the start of production.

A knowledge-based acquisition approach is a cumulative process in which certain knowledge is acquired by key decision points before proceeding. In other words, demonstrating technology maturity is a prerequisite for moving forward into system development, during which the focus should be on design and integration.

Additional details about each of our five observations on DOD's adherence to these knowledge points follow.

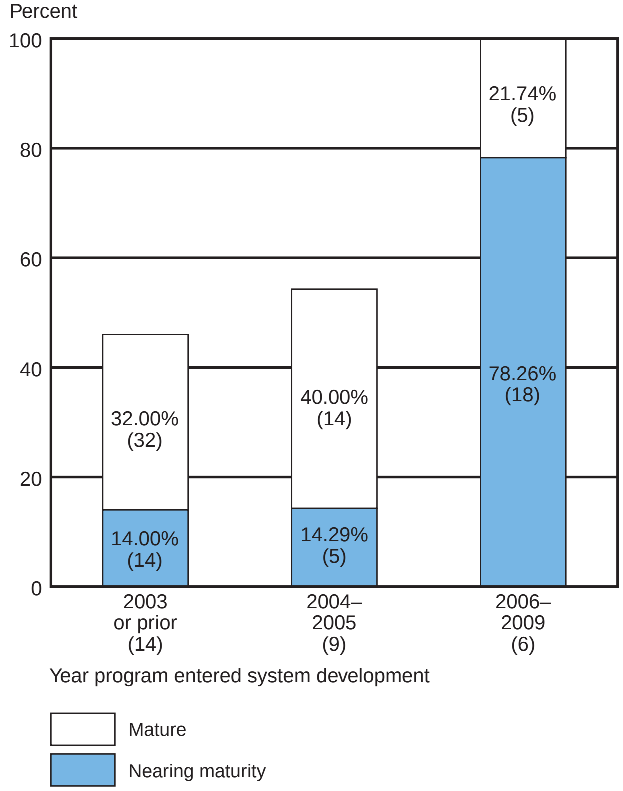
- **Newer programs are beginning with higher levels of technology maturity, but they are not taking key steps to ensure there is a match between requirements and resources.** Since 2006, there has been a significant increase in the percentage of technologies demonstrated in a relevant or realistic environment by the start of

system development.[15] This increase coincided with a change in statute. In 2006, the National Defense Authorization Act included a provision requiring all major defense acquisition programs seeking milestone B approval—entry into system development—to get a certification stating the program's technologies have been demonstrated in a relevant environment.[16] While only one of the six programs that entered system development since 2006 and provided data had fully mature critical technologies—that is, demonstrated in a realistic environment, according to our criteria—all the programs had critical technologies that had been at least demonstrated in a relevant environment (see fig. 1). Overall, only 4 of the 29 programs in our assessment that provided data on technical maturity at development start did so with fully mature critical technologies.

[15] Demonstration in a relevant environment is Technology Readiness Level (TRL) 6. Demonstration in a realistic environment is TRL 7. See app. III for a detailed description of TRLs.

[16] A major defense acquisition program may not receive milestone B approval until the milestone decision authority certifies that the technology in the program has been demonstrated in a relevant environment. National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 801 (codified at 10 U.S.C. § 2366b(a)(3)(D)).

Figure 1: Percentage of Technologies That Were Mature and Nearing Maturity When Selected Programs Entered System Development



Source: GAO analysis of DOD data.

Note: The number of programs entering system development is in parentheses under the years. The number of critical technologies for those programs is in parentheses in the bars.

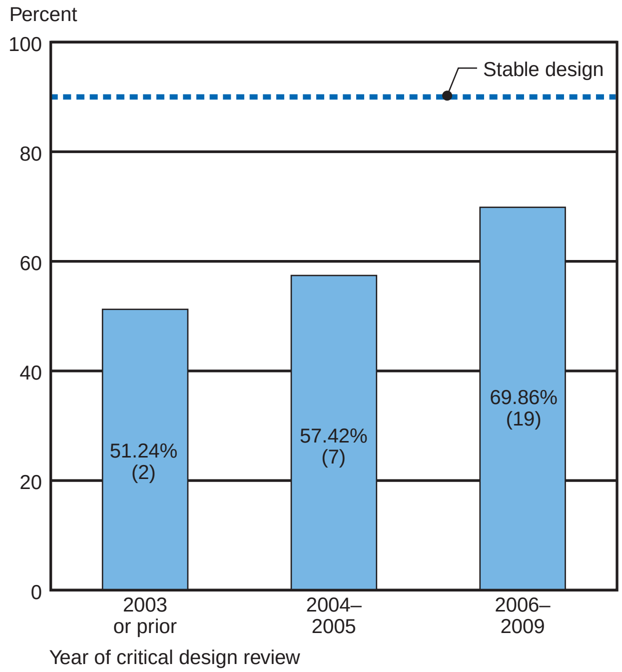
While the technology levels of DOD programs entering system development have increased, these programs are still not regularly conducting early systems engineering reviews, which help ensure there is a match between requirements and resources. We have previously reported that before starting development, programs should hold systems engineering events, such as the preliminary design review, to ensure that requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints. Our assessment last year found that programs conducting these events prior to development start experienced less research and development cost growth and shorter delays in the delivery of initial operational capabilities than programs that conducted these reviews after

development start. Almost all nonship programs (37 of 40 that provided data) in our assessment have held at least one of three key systems engineering reviews (system requirements review, system functional review, and preliminary design review). However, only 1 of these 37 programs held a preliminary design review before the start of system development. The remaining programs held the review, on average, 30 months after development start. The Weapon Systems Acquisition Reform Act of 2009 established a statutory requirement for programs to conduct a preliminary design review before milestone B, so we expect improvements in this area.[17]

- **Programs that have held critical design reviews in recent years reported higher levels of design knowledge; however, few programs are demonstrating that the design is capable of meeting performance requirements by testing an integrated prototype.** Knowing a product's design is stable before system demonstration reduces the risk of costly design changes occurring during the manufacturing of production-representative prototypes—when investments in acquisitions become more significant. The overall design knowledge that programs have demonstrated at their critical design reviews has increased since 2003. Programs in our assessment that held a critical design review between 2006 and 2009 had, on average, almost 70 percent of their design drawings releasable at the time of the review, which is a consistent upward trend since 2003 (see fig. 2).

[17]Under the Weapon System Acquisition Reform Act of 2009, a major defense acquisition program may not receive milestone B approval until the program has held a preliminary design review and the milestone decision authority has conducted a formal postpreliminary design review assessment and certified on the basis of such assessment that the program demonstrates a high likelihood of accomplishing its intended mission. Pub. L. No. 111-23, § 205(a)(3) (codified as amended at 10 U.S.C. § 2366b(a)(2)).

Figure 2: Average Percent of Total Expected Design Drawings for Selected Programs That Are Releasable at Critical Design Review



Source: GAO analysis of DOD data.

Note: Number of programs in parentheses.

However, most designs are still not stable at this point. Of the 28 programs in our assessment that have held a system-level critical design review, only 8 reported having a stable design. Only 2 of the 5 programs that held a critical design review in 2009 had a stable design at that point. The 5 programs reported that, on average, 83 percent of the total expected drawings were releasable.

While the design knowledge of DOD programs at the system-level critical design review has increased since 2003, these programs are still not regularly demonstrating that these designs can meet performance requirements by testing integrated prototypes before the critical design review—a best practice. We have previously reported that early system prototypes are useful to demonstrate design stability and that the design will work and can be built. None of the 5 programs that held their critical design review in 2009 and planned to test a prototype did so before the review. Of the 33 programs that reported that they either had tested or were

going to test an early system prototype and provided a critical design review date, only 4 did so before their critical design review.[18] The remaining programs tested or will test their prototype, on average, 31 months after their critical design review. While few programs test integrated prototypes by the critical design review, DOD programs are testing prototypes earlier. As shown in table 2, programs that held or will hold their critical design reviews in 2004 or later are testing or plan to test an integrated prototype much sooner than programs with design reviews in 2003 or earlier.

Table 2: Programs Testing an Early System Prototype

	Year of critical design review				
	2003 or prior	2004–2005	2006–2009	2010 and later	All programs
Number of programs testing before critical design review	1	0	3	0	**4**
Number of programs testing after critical design review	3	6	15	5	**29**
For programs testing after critical design review, average number of months from design review to prototype test	74	29	27	18	**31**

Source: GAO analysis of DOD data.

The Weapon Systems Acquisition Reform Act of 2009 requires that DOD policy ensure that the acquisition strategy for each major defense acquisition program provides for competitive prototypes before milestone B approval, unless a waiver is properly granted.[19] This requirement should increase the percentage of programs demonstrating that the system's design works as intended before the critical design review.

[18]One program that held a critical design review in 2009 did not plan to test an early systems prototype.

[19]Pub. L. No. 111-23, § 203(a).

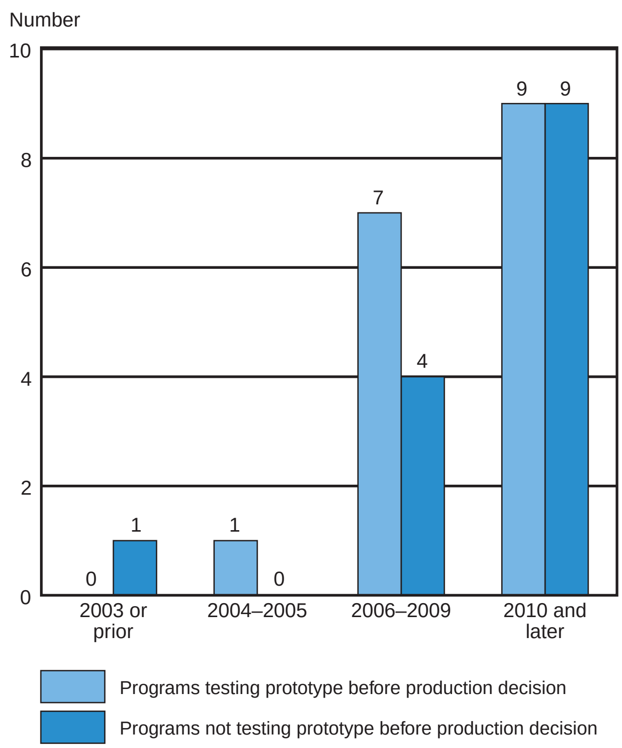
- **Some programs are taking steps to bring critical manufacturing processes into control; however, many programs still rely on "after the fact" metrics, such as defects and rework, to measure manufacturing process maturity.** Capturing critical manufacturing knowledge before entering production helps ensure that a weapon system will work as intended and can be manufactured efficiently to meet cost, schedule, and quality targets. Identifying key product characteristics and the associated critical manufacturing processes is a key initial step to ensuring production elements are stable and in control. Seven programs in our assessment have identified their critical manufacturing processes, including four of the programs that entered production in 2009. Three of those seven programs reported that their critical manufacturing processes were in control.[20] Bringing processes under statistical control reduces variations in parts manufactured, thus reducing the potential for defects. It is generally less costly—in terms of time and money—to eliminate product variation by controlling manufacturing processes than to perform extensive inspection after a product is built. However, many DOD programs rely on inspecting produced components instead of using statistical process control data in order to assess the maturity of their production processes. For example, 12 programs in our assessment reported tracking defects in delivered units, nonconformances, or scrap/rework as a way to measure production process maturity. The use of "after the fact" metrics is a reactive approach towards managing manufacturing quality as opposed to a prevention-based approach. DOD is proposing the use of manufacturing readiness levels, which include process controls, as a common standard for identifying, communicating, and managing manufacturing risk and readiness.

- **Programs are still not regularly testing production-representative prototypes before committing to production.** We have previously reported that in addition to demonstrating that the system can be built efficiently, production and postproduction costs are minimized when a fully integrated, capable prototype is demonstrated to

[20]DOD policy states that the knowledge required for a major defense acquisition program to proceed beyond low-rate initial production shall include demonstrated control of the manufacturing process and acceptable reliability, the collection of statistical process control data, and demonstrated control and capability of critical processes. Department of Defense Instruction 5000.02, Operation of the Defense Acquisition System, enclosure 2, paragraph 7.c.(2) (Dec. 8, 2008). We did not specifically assess compliance with this requirement.

show that the system will work as intended and in a reliable manner. The benefits of testing are maximized when the tests are completed prior to a production decision because making design changes after production begins can be both costly and inefficient. However, of the 32 programs in our assessment that could have tested a prototype before production, only 17 either tested or expect to test a fully configured, integrated, production-representative prototype before holding their production decision review. In December 2008, DOD changed its policy to require programs to test production-representative articles before entering production. Three of the five programs that held their production decision in 2009 reported testing a production-representative prototype before their production decision. However, as figure 3 shows, only 9 of the 18 programs planning to hold their production decision review in 2010 and beyond plan to test a prototype before that decision.

Figure 3: Programs Testing a Production-Representative Prototype before and after a Production Decision



Source: GAO analysis of DOD data.

- **More programs are using reliability growth curves before beginning production.** Reliability growth testing provides visibility over how reliability is improving and uncovers design problems so fixes can be incorporated before production begins. According to DOD's acquisition policy, a major defense acquisition program may not proceed beyond low-rate initial production until it has demonstrated acceptable reliability. Over half—22 of 40 programs that responded to our questionnaire—reported that they use a reliability growth curve, with 18 of these programs reporting they are currently meeting their established goals. Programs that have held production decisions since 2009 are more likely to use reliability growth curves compared to programs that held production decisions before 2009. Three of the five programs that held their production decision in 2009 reported using a reliability growth curve, with all three reporting that they are meeting their goals. In addition, 12 of 19 programs that expect to hold their production decision in 2010 and beyond use reliability growth curves and most are currently meeting their goals. This practice should help these programs begin production with a reliable product design.

Observations on Other Factors That Can Affect Program Execution

In addition to collecting and analyzing data on the attainment of knowledge at key junctures in an acquisition program, we also collected and assessed data on other areas related to DOD's management of its weapons programs, including requirements, software management, and program office staffing. We have previously identified requirements changes and increases in software lines of code as sources of program instability that can contribute to cost growth and schedule delays. Our analysis of the data we collected in these areas allows us to make three observations. First, a majority of the programs in our current assessment reported experiencing requirements changes after starting development, resulting in major cost and schedule effects for eight programs. Second, a majority of programs have also either experienced growth in software lines of code or are at risk of doing so in the future. Third, program offices reported experiencing workforce challenges that hindered program execution and negatively affected program management and oversight. As a result of shortfalls in government personnel and capabilities, programs in our current assessment are relying heavily on support contractors to fill these gaps. Additional details about each of these three observations follow.

- **A majority of programs changed key systems requirements after development start.** We reported in our last assessment that programs that changed key system requirements after starting development

experienced greater cost increases and schedule delays than programs with no requirements changes. Of the 42 programs in our current assessment that reported tracking requirements changes, 23 programs reported having had at least one change (addition, reduction, enhancement, or deferment) to a key performance parameter—a top-level requirement—since development start—up from 22 programs in last year's assessment. Further, nine programs experienced at least one change to a key system attribute—a lower level, but still a crucial requirement of the system. Eight programs reported major effects on the program as a result of these requirements changes, such as not meeting acquisition program baseline cost, schedule, and performance thresholds. DOD's revised December 2008 acquisition policy attempts to reduce potentially disruptive requirements changes by requiring programs to hold annual configuration steering board meetings to ensure that significant technical changes are not approved without considering their effect on cost and schedule.

- **Many programs are at risk for cost growth and schedule delays because of software development issues.** We reported in our last assessment that programs experiencing more than a 25 percent growth in software lines of code since development start had higher development cost growth and longer schedule delays than other programs. Seventeen of the 28 programs that reported data on software lines of code estimated that the number of lines of code required for the system to function has grown or will grow by 25 percent or more—up from 14 programs in our last assessment. Overall, the average lines of code growth or planned growth for the 28 programs was about 92 percent. In addition to measuring growth in software lines of code, we have previously reported that collecting earned value management data for software development and tracking and containing software defects in phase are good management practices. Overall, 30 programs in our assessment reported collecting earned value management data to help manage software development. Thirty-two programs in our assessment reported collecting some type of software defect data. For the 22 programs that responded to a more specific question about defect correction, on average, only 69 percent of the defects were corrected in the phase of software development in which they occurred. Capturing software defects in-phase is important because discovering defects out of phase can cause expensive rework later in programs.

- **Programs' reliance on nongovernment personnel continues to increase in order to make up for shortfalls in government**

personnel and capabilities. In recent years, Congress and DOD have taken steps to ensure the acquisition workforce has the capacity, personnel, and skills needed to properly perform its mission; however, programs continue to struggle to fill all staff positions authorized. Only 19 of the 50 programs that responded to our questions on staffing were able to fill all the positions they had been authorized.[21] A commonly cited reason for not being able to fill positions was difficulty finding qualified candidates. As a result of staff shortfalls, program offices reported that program management and oversight has been degraded, contracting activities have been delayed, and program management costs have increased as contractors are used to fill the gap. Overall, 43 programs or 86 percent of those providing data reported utilizing support contractors to make up for shortfalls in government personnel and capabilities.

Program offices' reliance on contractors has continued to increase. For the first time since we began reporting on program office staffing in 2008, programs reported having more nongovernment than government staff working in program offices. As shown in table 3, for the 50 programs in our assessment that responded, nongovernment staff constituted approximately 51 percent of the total program office workforce—up from 48 percent in 2008.

Table 3: Program Office Composition for 50 DOD Programs

Percentage of staff

	Program management	Engineering and technical	Contracting	Other business functions	Administrative support	Other	Total
Military	28	7	6	3	2	5	**8**
Civilian government	40	41	74	45	18	24	**40**
Total government	**67**	**47**	**80**	**48**	**20**	**29**	**49**
Support contractors	32	43	20	50	78	70	**45**
Other nongovernment[a]	0	9	0	3	2	1	**6**
Total nongovernment	**33**	**53**	**20**	**52**	**80**	**71**	**51**

Source: GAO analysis of DOD data.

Notes: Totals may not add due to rounding.

[a]Other nongovernment includes federally funded research and development centers, universities, and affiliates.

[21]In addition to data from 46 major defense acquisition programs, our analysis of program staffing includes data from four Missile Defense Agency programs.

The increasing number of support contractors accounts for this steady growth. This year, support contractors made up about 45 percent of program office staff—up from 36 percent in 2008. The greatest numbers of support contractors are in engineering and technical positions, but their participation has increased in all areas, from program management and contracting to administrative support and other business functions.

Observations about DOD's Implementation of Acquisition Reforms

DOD has begun to incorporate acquisition reforms into the acquisition strategies for new programs. Both DOD's December 2008 acquisition policy revisions and the Weapon Systems Acquisition Reform Act of 2009 require programs to invest more time and resources in the front end of the acquisition process—refining concepts through early systems engineering, developing technologies, and building prototypes before starting system development. In addition, DOD policy requires establishment of configuration steering boards that meet annually to review all program requirements changes as well as to make recommendations on proposed descoping options that could help keep a program within its established cost and schedule targets. These steps could provide a foundation for establishing sound, knowledge-based business cases for individual weapon programs and are consistent with many of our past recommendations; however, if reform is to succeed and weapon program outcomes are to improve, they must be reinforced in practice through decisions on individual programs. Our analysis of the programs in our assessment allows us to make two observations about the extent to which DOD is implementing recent acquisition reforms. First, ten programs in our assessment have not yet entered system development and most reported having acquisitions strategies consistent with both DOD's revised acquisition policy and the provisions of the Weapon Systems Acquisition Reform Act of 2009. Second, seven programs in our assessment reported holding configuration steering boards in 2009. Additional details about both of observations follow.

- **Almost all the pre–major defense acquisition programs in our assessment plan to develop competitive prototypes and conduct a preliminary design review before development start.** Consistent with the new requirement in the Weapon Systems Acquisition Reform Act of 2009, 8 of 10 pre–major defense acquisition programs in our assessment reported planning to develop competitive prototypes of the

proposed weapon system or key system elements before milestone B.[22] The programs include the 3rd Generation Infrared Surveillance, Air and Missile Defense Radar, Common Infrared Countermeasures, Joint Air-to-Ground Missile, Joint Light Tactical Vehicle, Next Generation GPS Control Segment, Maritime Prepositioning Force (Future) Mobile Landing Platform, and Small Diameter Bomb Increment II. The B-2 EHF SATCOM Increment 2 did not report that competitive prototypes were part of its acquisition strategy. In addition, 7 of 10 pre–major defense acquisition programs in our assessment have already scheduled a preliminary design review before milestone B, consistent with the new requirement in the Weapon Systems Acquisition Reform Act of 2009.[23] One program—the Navy's Sea Based Strategic Deterrent—is not in the technology development phase and, therefore, has not put forth a technology development strategy that would include competitive prototypes or a scheduled preliminary design review. In addition to programs planning to develop competitive prototypes and conduct early systems engineering reviews, we have seen examples of programs focusing on developing realistic requirements. For example, the B-2 EHF Increment 2 is currently reexamining its requirements after early reviews and trade studies found that they could not be met with existing technologies.

- **Only a few programs reported holding configuration steering boards to review requirements changes, significant technical changes, or de-scoping options in 2009.** We have previously reported that requirements changes and the inability of the program manager to defer requirements that could not be completed under existing cost and schedule targets are factors in poor acquisition program outcomes. Under DOD's revised acquisition policy, ongoing programs are required to conduct annual configuration steering boards to review requirements changes and significant technical configuration changes that have the

[22]The Weapon Systems Acquisition Reform Act of 2009 requires that DOD policy ensure that the acquisition strategy for each major defense acquisition program provides for competitive prototypes before milestone B approval, unless a waiver is properly granted. Pub. L. No. 111-23, § 203(a).

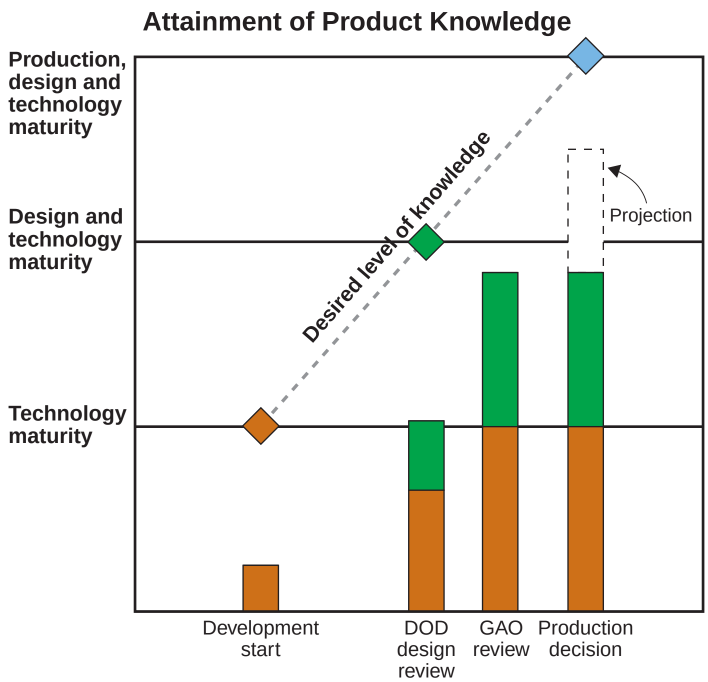
[23]The Weapon System Acquisition Reform Act of 2009 establishes a statutory requirement that a major defense acquisition program may not receive milestone B approval until the milestone decision authority has received a preliminary design review, conducted a formal postpreliminary design review assessment, and certified on the basis of such assessment that the program demonstrates a high likelihood of accomplishing its intended mission. Pub. L. No. 111-23, § 205(a)(3) (codified as amended at 10 U.S.C. § 2366b(a)(2)).

potential to result in cost and schedule effects on the program. In addition, the program manager is expected to present de-scoping options to the board that could reduce program costs or moderate requirements. Only seven programs in our assessment reported holding a configuration steering board meeting in 2009. None of the programs reported that the board approved requirements changes or significant technical changes. However, the P-8A program presented de-scoping options to decrease the cost and schedule risk on the program and reported that those options were approved.

How to Read the Knowledge Graphic for Each Program Assessed

For our two-page assessments, we depict the extent of knowledge gained by key points in a program using a stacked bar graph and provide a narrative summary at the bottom of the first page of each assessment. As illustrated in figure 4, the knowledge graph is based on three knowledge points. The key indicators for the attainment of knowledge are technology maturity (in orange), design stability (in green), and production maturity (in blue). A "best practice" line is drawn based on the ideal attainment of the three types of knowledge at the three knowledge points. The closer a program's attained knowledge is to the best practice line; the more likely the weapon will be delivered within estimated cost and schedule. A knowledge deficit at development start—indicated by a gap between the technology maturity attained and the best practice line—means the program proceeded with immature technologies and faces a greater likelihood of cost and schedule increases as risks are discovered and resolved.

Figure 4: Depiction of Notional Weapon System Knowledge as Compared with Best Practices



Source: GAO.

An interpretation of this notional example would be that system development began with critical technologies that were partially immature, thereby missing knowledge point 1 indicated by the orange diamond. By the design review, technology knowledge had increased, but all critical technologies were not yet mature, and only 33 percent of the program's design drawings were releasable to the manufacturer. Therefore, knowledge point 2, as indicated by the green diamond, was not attained. At the time of GAO's review, this program had matured all of its critical technologies and released approximately 75 percent of its design drawings. When the program plans to make a production decision, it expects to have released all of its design drawings and have half of its critical manufacturing processes in statistical control. The expected knowledge at this future point is captured in the outlined region marked "projection."

This program is not projected to reach knowledge point 3, indicated by the blue diamond, by the time it makes a production decision.[24]

Assessments of Individual Programs

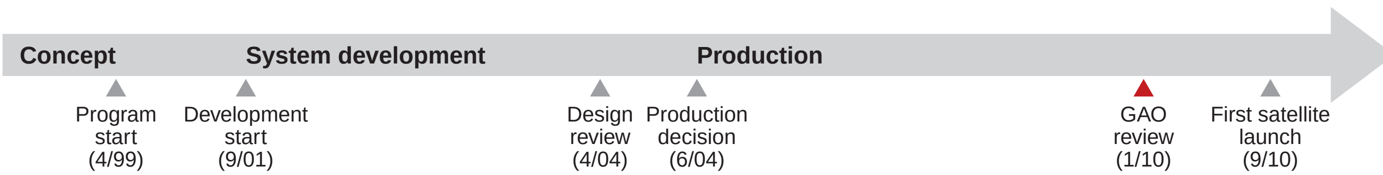
This section contains assessments of individual weapon programs. Each assessment presents data on the extent to which programs are following a knowledge-based approach to system development and other program information. In total, we present information on 70 weapon programs. For 57 programs, we produced two-page assessments discussing technology, design, and manufacturing knowledge obtained, as well as other program issues. Forty-seven of these assessments are of major defense acquisition programs, most of which are in development or early production; eight assessments are of components of major defense acquisition programs, including elements of MDA's Ballistic Missile Defense System; and three assessments are of programs that were projected to become major defense acquisition programs during our review. The other 13 programs, which include 8 pre–major defense acquisition programs, 2 major defense acquisition programs that were terminated or are ending, 1 major defense acquisition program that is a commercially-derived aircraft, 1 MDA element, and 1 acquisition category II program are covered in a one-page format that describes their current status.

[24] For shipbuilding programs, knowledge point 1 occurs when a program awards a detailed design and construction contract, and knowledge point 2 occurs when the lead ship starts fabrication. We do not assess production maturity at knowledge point 3 for shipbuilding programs.

Advanced Extremely High Frequency (AEHF) Satellites

The Air Force's AEHF satellite system will replenish the existing Milstar system with higher-capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters. The program includes satellites and a mission control segment. Terminals used to transmit and receive communications are acquired separately by each service. AEHF is an international partnership program that includes Canada, the United Kingdom, and the Netherlands. We assessed the satellite and mission control segments.

Source: © 2009 Lockheed Martin Corporation. All rights reserved.



Program Essentials

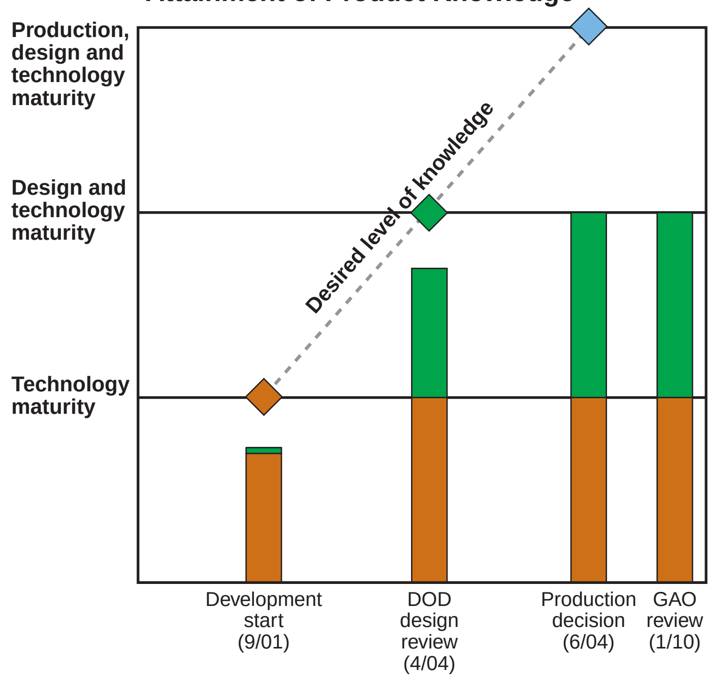
Prime contractor: Lockheed Martin
Program office: El Segundo, CA
Funding needed to complete:
R&D: $1,022.0 million
Procurement: $2,171.3 million
Total funding: $3,193.3 million
Procurement quantity: 1

Program Performance (fiscal year 2010 dollars in millions)

	As of 10/2001	Latest 09/2008	Percent change
Research and development cost	$4,796.0	$7,277.5	51.7
Procurement cost	$1,418.5	$3,129.4	120.6
Total program cost	$6,214.5	$10,406.8	67.5
Program unit cost	$1,242.896	$2,601.707	109.3
Total quantities	5	4	-20.0
Acquisition cycle time (months)	111	170	53.2

The AEHF program has overcome the technical problems that have delayed the first satellite's launch by almost 2 years and increased the cost of the program. Defective satellite parts were replaced and the satellite successfully completed system-level environmental testing. The satellite is now proceeding to final testing before its scheduled September 2010 launch. The AEHF technologies are mature and the design appears stable. We could not assess production maturity because the program does not collect statistical process control data. Three satellites have been added to the program in recent years because of concerns about delays in and the subsequent recommended termination of the Transformational Satellite (TSAT) program. Satellites four through six will cost significantly more than the third satellite because of parts obsolescence issues and a 4-year break in production.

Attainment of Product Knowledge



AEHF Program

Technology and Design Maturity

According to the program office, all 14 AEHF critical technologies are mature, with all either flight-qualified through test and demonstration or flight-proven through successful mission operations. System-level environmental testing for the first satellite was completed in July 2009. The AEHF's design appears stable with all of its expected design drawings released.

Production Maturity

We could not assess production maturity because the program office does not collect statistical process control data. However, during initial system level environmental testing for the first and second satellites, several flight boxes experienced failures due to defective components that required removal, repair, and reinstallation. Because of the number of components that had to be removed and reinstalled, the first satellite had to undergo an additional round of system-level environmental tests. These actions delayed the first launch almost 2 years and increased program cost. According to the program office, the additional testing was successfully completed in July 2009. The second satellite also completed system level environmental testing in 2009, and no new problems or issues were discovered. The first satellite will now proceed to final testing, which includes verifying satellite interfaces and functions and that the space, ground control, and terminals segments perform together as expected. The satellite will then be prepared for its scheduled September 2010 launch. Launches for satellites 2 and 3 are scheduled for May 2011 and January 2012, respectively.

Other Program Issues

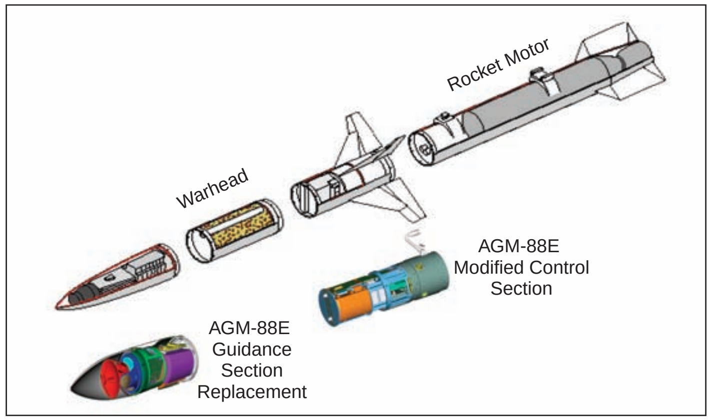
The number of AEHF satellites to be procured has changed over time. The original AEHF program included the purchase of five satellites. In December 2002, satellites 4 and 5 were deleted from the program with the intention of using the first TSAT satellite to achieve full operational capability. However, because of concerns about TSAT development and a possible gap in capability, the conference report accompanying the fiscal year 2008 Defense Appropriations Act recommended funding for the advanced procurement of a fourth satellite, which the Air Force fully funded in the fiscal year 2010 budget for about $1.5 billion (then-year dollars). This satellite is expected to launch in 2016. The cost of the fourth satellite is significantly more than the estimated $952 million (then-year dollars) cost of the third satellite because there is an estimated 4-year break in production and some electronics components are no longer manufactured. Program officials do not anticipate significant technical challenges, but integrating, testing, and requalifying the new components will require time and money. In addition, in April 2009, DOD announced its intention to terminate the TSAT program and procure two additional AEHF satellites, bringing the total to six. The program has decided that the design specifications for the first three satellites will remain unchanged for satellites four through six, which will be clones except for obsolete parts. The program office estimates the cost of satellites five and six will be about $1.6 billion and $1.7 billion (then-year dollars), respectively, with estimated launch dates in 2018 and 2020.

Program Office Comments

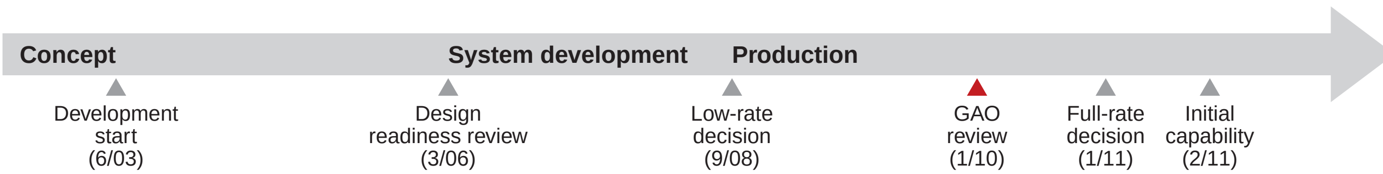
The AEHF program office provided technical comments, which we incorporated as appropriate.

AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)

The Navy's AARGM is an air-to-ground missile for carrier-based aircraft designed to destroy enemy radio-frequency-enabled surface-to-air defenses. The AARGM is an upgrade to the AGM-88 High Speed Anti-Radiation Missile (HARM). It will utilize the existing HARM propulsion and warhead sections, a modified control section, and a new guidance section with Global Positioning System and improved targeting capabilities. The program is following a phased approach for development. We assessed phase I and made observations on phases II and III.



Source: AGM-88E AARGM Program Office (PMA).



Program Essentials

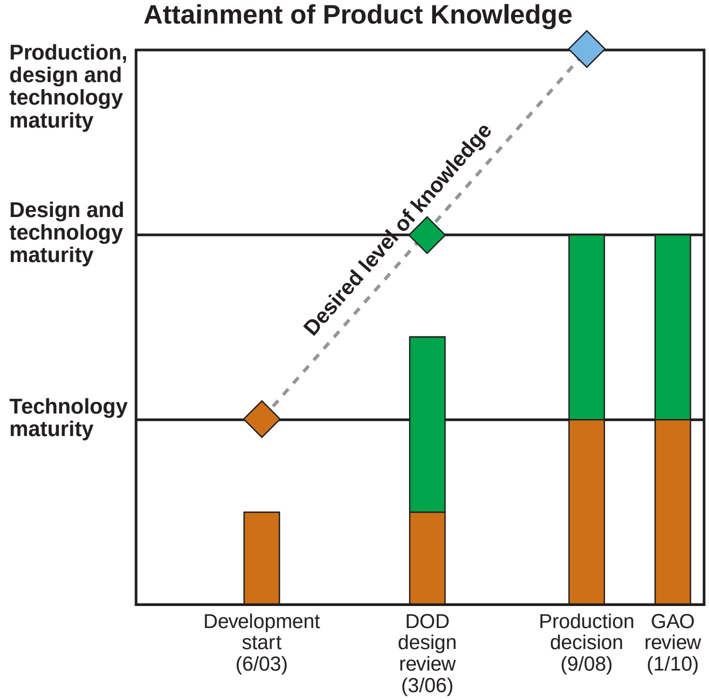
Prime contractor: ATK Missile Systems Company
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $3.5 million
- Procurement: $1,232.2 million
- Total funding: $1,235.7 million
- Procurement quantity: 1,841

Program Performance (fiscal year 2010 dollars in millions)

	As of 07/2003	Latest 08/2009	Percent change
Research and development cost	$621.6	$665.7	7.1
Procurement cost	$940.0	$1,292.7	37.5
Total program cost	$1,561.5	$1,958.4	25.4
Program unit cost	$.872	$1.025	17.5
Total quantities	1,790	1,911	6.8
Acquisition cycle time (months)	85	92	8.2

The AARGM program awarded a contract for the first lot of low-rate initial production in December 2008. According to the program office, its critical technologies are mature and its design is stable. Software development is nearing completion. However, the contractor has not yet demonstrated that production processes are fully mature. The program office has identified the number of critical manufacturing processes and stated that the contractor was to begin collecting statistical process control data in December 2009. According to the program office, deficiencies related to the missile's capabilities were identified during developmental testing in the last year, which has delayed the start of operational evaluation by 4 months. The program also is in the process of coordinating approval from the Navy to defer demonstration of one aspect of a key performance parameter.

Attainment of Product Knowledge



AGM-88E AARGM Program

Technology Maturity

The AARGM program began system development in 2003 with its two critical technologies—the millimeter wave software and radome—nearing maturity and demonstrated in a relevant environment. According to the program office, these technologies were mature and demonstrated in a realistic environment when the program received approval to enter production in September 2008. However, according to DOT&E, the missile's millimeter wave capabilities were not fully demonstrated during the program's operational assessment in order to avoid a delay in the program's production decision. According to the program office, these capabilities have been demonstrated during subsequent developmental tests. During these tests, the program identified deficiencies related to the missile's reliability and situational awareness. As a result, program officials stated that the start of operational evaluation will be delayed 4 months until February 2010. In addition, program officials said that the missile is not fully meeting its lethality requirement for a specific target in a specified scenario. The program is in the process of obtaining approval from the Navy to defer demonstration of this requirement to follow-on operational testing and evaluation.

The AARGM program will incorporate additional capabilities in phase II and phase III of the program. The weapons impact assessment transmitter and integrated broadcast service receiver are key enablers of these capabilities. According to program officials, both technologies are mature and were demonstrated in a realistic environment during developmental testing.

Design Maturity

The design of the AARGM is currently stable and all of the drawings were released to manufacturing by the start of production. The program office reports that it is nearing completion of software development efforts and has tested, integrated, and released 100 percent of the total lines of code.

Production Maturity

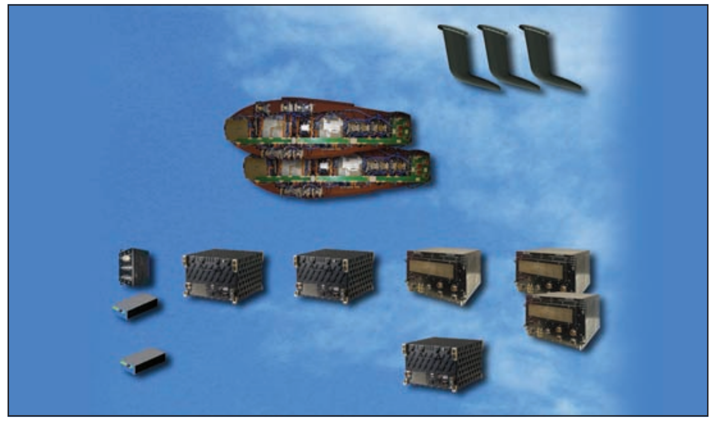
The AARGM program awarded a contract for the first lot of low-rate initial production in December 2008. However, the AARGM's production processes have not yet demonstrated their maturity because the contractor has not started collecting statistical process control data. The program has identified the number of critical manufacturing processes and expected the contractor to start collecting statistical process control data by the end of 2009. According to the Defense Contract Management Agency, the contractor is still finishing efforts under the system development and demonstration contract and has not yet fully moved into low-rate initial production. Delivery of the first unit is scheduled for January 2010. The contract provides incentives for on-time delivery of subsequent units.

Program Office Comments

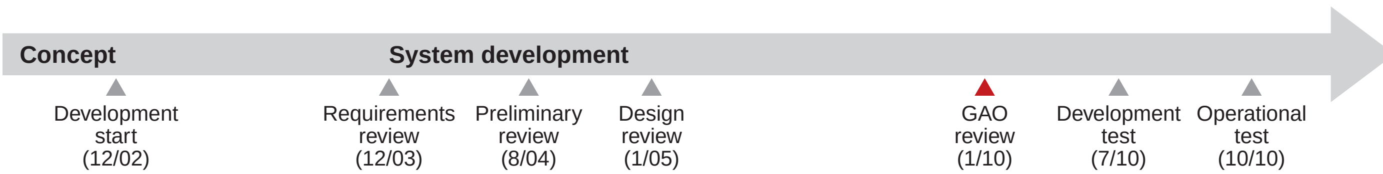
The program delayed entry into operational testing in September 2009 to correct key deficiencies identified toward the end of developmental testing. Since that time, the program corrected those deficiencies and completed all developmental flight testing events to support entry into operational testing, which will begin in February 2010. The first production units will be delivered in January 2010. The program continues to focus on affordability and is reporting a 1.3 percent average procurement unit cost growth against the current acquisition program baseline estimate.

Airborne Signals Intelligence Payload Baseline

The Air Force's Airborne Signals Intelligence Payload (ASIP) is a common, scalable family of sensors designed for medium- and high-altitude aircraft. ASIP sensors are expected to provide automatic, real-time, battlefield surveillance, situational awareness and intelligence information. The Air Force is developing three different ASIP variants, a baseline variant for use on the U-2 and Global Hawk, and two scaled-down variants referred to as ASIP 1C and ASIP 2C for Predator and Reaper respectively. We assessed the baseline variant.



Source: © 2003 Northrop Grumman.



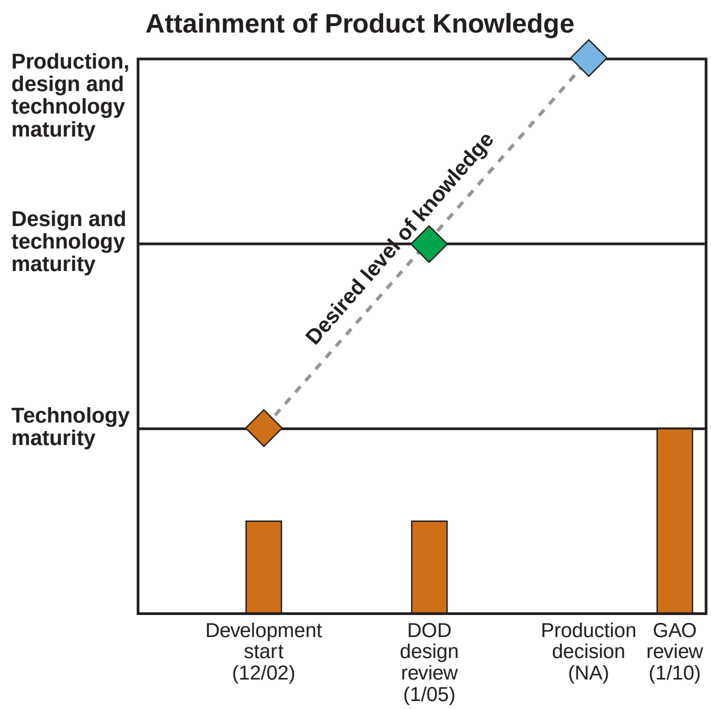
Program Essentials

Prime contractor: Northrop Grumman Corp.
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2002	Latest 08/2009	Percent change
Research and development cost	$338.6	$493.6	45.8
Procurement cost	$0.0	$0.0	0.0
Total program cost	$338.6	$493.6	45.8
Program unit cost	NA	$123.397	NA
Total quantities	NA	4	NA
Acquisition cycle time (months)	NA	NA	NA

The critical technologies for the baseline ASIP are mature and its design appears stable. However, ASIP has not been fully tested on Global Hawk and additional design work may be necessary. Operational testing of the sensor on Global Hawk will not begin until 2010 because of delays in the Global Hawk program. The ASIP program was granted approval to conduct operational test flights on a U-2. Program officials stated that U-2 test data will be used to help ensure that ASIP is ready to begin Global Hawk testing. We did not assess design stability using design drawing releases because the program does not track that data. Instead, officials noted that they track design stability by analyzing trends in the number of engineering changes. Trend data provided by the program office indicates a generally stable design. ASIP production will be funded and managed as part of the Global Hawk program.



ASIP Baseline Program

Technology Maturity

At the beginning of system development in 2002, all four critical technologies for the ASIP baseline sensor—spray cooling, VME receiver, high-band antenna array, and data encryptor—were nearing maturity. Developmental testing of the ASIP sensor began in late 2006. The sensor is now nearing the end of development; and according to the program office, all four critical technologies are fully mature, having been successfully demonstrated on the intended host aircraft. Operational testing of the ASIP sensor on Global Hawk has been delayed because of continuing developmental problems with the Global Hawk aircraft. However, the ASIP program office sought and was granted approval to conduct additional sensor evaluations on U-2 aircraft. The evaluations began in 2009, and program officials noted that the test data from those flights will be used to help ensure that ASIP is ready to begin Global Hawk initial operation testing and evaluation in 2010.

Design Maturity

The design of the ASIP baseline sensor appears stable; however, it has not been fully tested on Global Hawk and additional design work could still be necessary. We did not assess design maturity using design drawing releases because the program does not track that data. Instead, ASIP program officials noted that they assess design stability by tracking trends in the number of engineering changes. This trend data provided by the program office indicates that the sensor's design is generally stable.

Production Maturity

We did not assess production maturity because the ASIP program office is only responsible for developing and testing the sensor. The host aircraft program offices are responsible for managing and funding sensor production and integration. The ASIP program did produce four sensors for U-2 and Global Hawk testing.

Other Program Issues

In January 2009, the ASIP program was designated a major defense acquisition program because its estimated eventual total expenditure for research, development, test, and evaluation is more than $365 million (fiscal year 2000 dollars). According to the program office, the bulk of the cost growth experienced by the ASIP baseline sensor is primarily due to capability enhancements, Global Hawk schedule delays, and the need to purchase two more developmental sensors than originally planned. Program officials stated that although the baseline sensor's development is on schedule, testing of the sensor continues to be adversely affected by delays in Global Hawk development and testing.

DOD has also noted that it wants to oversee all ASIP variants as part of a system of systems. However, officials stated that the Air Force will continue to manage the program as though it were three separate programs. ASIP 1C is being developed for possible integration onto the MQ-1 Predator. ASIP 2C is expected to be a larger variant of the ASIP 1C. It will be used on the MQ-9 Reaper and potentially on the Army's Extended Range Multi-Purpose unmanned aircraft. The ASIP 2C has not yet officially begun development, but a study is ongoing to determine the potential of this sensor to meet the signals intelligence needs of both the Air Force and the Army.

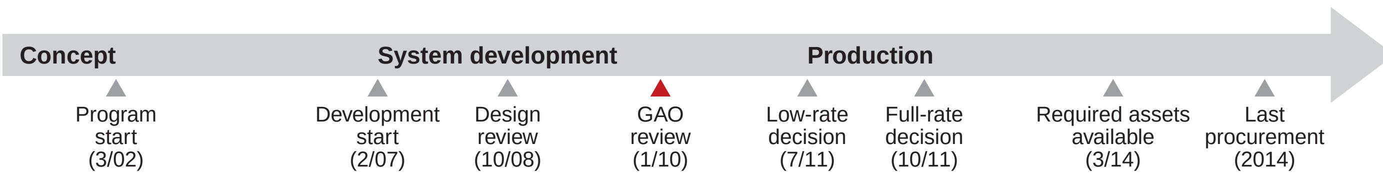
Program Office Comments

The program office concurred with this assessment.

B-2 Spirit Advanced Extremely High Frequency (EHF) SATCOM Capability Increment 1

The Air Force's B-2 EHF SATCOM is a satellite communication upgrade being developed in three increments. Increment 1 upgrades computing system speed and storage capacity of the current avionics infrastructure with new integrated processing units and disk drive units that will facilitate future B-2 upgrades. Increment 2 will ensure survivable strategic connectivity by adding low-observable antennas and radomes. Increment 3 will enable connectivity with the Global Information Grid. We assessed Increment 1.

Source: B-2 Systems Group 1999, USAF photo.



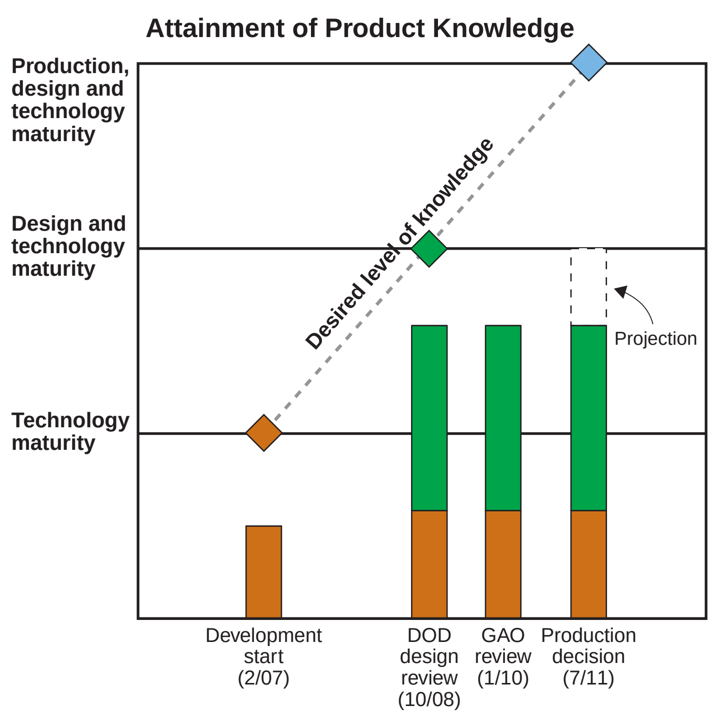
Program Essentials

Prime contractor: Northrop Grumman
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
R&D: $230.2 million
Procurement: $123.8 million
Total funding: $353.9 million
Procurement quantity: 16

Program Performance (fiscal year 2010 dollars in millions)

	As of 05/2007	Latest 08/2009	Percent change
Research and development cost	$571.9	$521.0	-8.9
Procurement cost	$120.5	$123.8	2.7
Total program cost	$692.4	$644.8	-6.9
Program unit cost	$32.972	$32.238	-2.2
Total quantities	21	20	-4.8
Acquisition cycle time (months)	85	85	0.0

According to the program office, the B-2 EHF SATCOM Increment 1 will have mature critical technologies and a stable design by its planned July 2011 production decision. The program office expects all critical technologies to be flight qualified through test and demonstration by the production start. The current software development plan is on track and progressing toward certification in April 2010. The program expects flight testing with certified software to begin in spring 2010. As of September 2009, 8 of 10 software blocks had completed integration testing, with the core software increments having demonstrated full functionality in testing. The 10th software block is being used to correct any deficiencies identified in the overall software build.



B-2 EHF SATCOM Inc 1 Program

Technology Maturity

Increment 1 of the B-2 EHF SATCOM program entered system development in February 2007 with all six of its critical technologies near maturity. The program office expects all critical technologies to be mature and flight qualified by the program's planned July 2011 production decision. According to program officials, development and successful integration of new disk drive units (DDU) and integrated processing units (IPU) is the primary objective for Increment 1. According to the Air Force, DDU qualification and design verification testing has been completed without discovering any significant issues. IPU durability testing and flight test airworthiness testing is also completed.

Design Maturity

The B-2 EHF Increment 1 design appears stable. According to the program office, all of the expected drawings were releasable at the October 2008 design review.

The B-2 EHF SATCOM Increment 1 program has recovered from early software development issues that delayed the start of developmental test and evaluation by about 9 months. In 2008, the Increment 1 software plan was revised because software requirements for each block were not defined upfront. The revised development plan stated the requirements for all software components must be defined before coding begins. It also added three preliminary software blocks, which have reduced the risk of late problem discovery and accelerated integration testing of key functionality. According to program officials, the software development has remained on schedule since the revision. As of September 2009, 8 of 10 software blocks had completed integration testing, with the core software increments having demonstrated full functionality in testing. The 10th software block is being used to correct any deficiencies identified in the overall software build. Software certification is scheduled for April 2010 and first flight test is expected in spring 2010.

Other Program Issues

Due to the limited availability of the one B-2 test aircraft, flight testing for EHF Increment 1 is scheduled to occur in tandem with another acquisition program. Program officials emphasized the B-2 EHF SATCOM Increment 1 will not be held up by any schedule delays that might occur with its test partner because the B-2 EHF SATCOM is not dependent on the other program to meet its test objectives. If the other program is not ready for testing, then the B-2 EHF SATCOM program will proceed with its scheduled flight tests without the other program.

Program Office Comments

The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

BMDS Airborne Laser (ABL)

MDA's ABL element is being developed to negate enemy missiles during the boost phase of flight. The current program will not result in an operational system. Carried aboard a modified Boeing 747 aircraft, ABL employs a battle management subsystem to plan and execute engagements, a high-energy chemical laser to rupture the fuel tanks of enemy missiles, and a beam control/fire control subsystem to focus the high-energy laser beam on the target. We assessed the prototype design that is expected to lead to a lethality demonstration in 2010.

Source: Airborne Laser Program Office.

Program Essentials

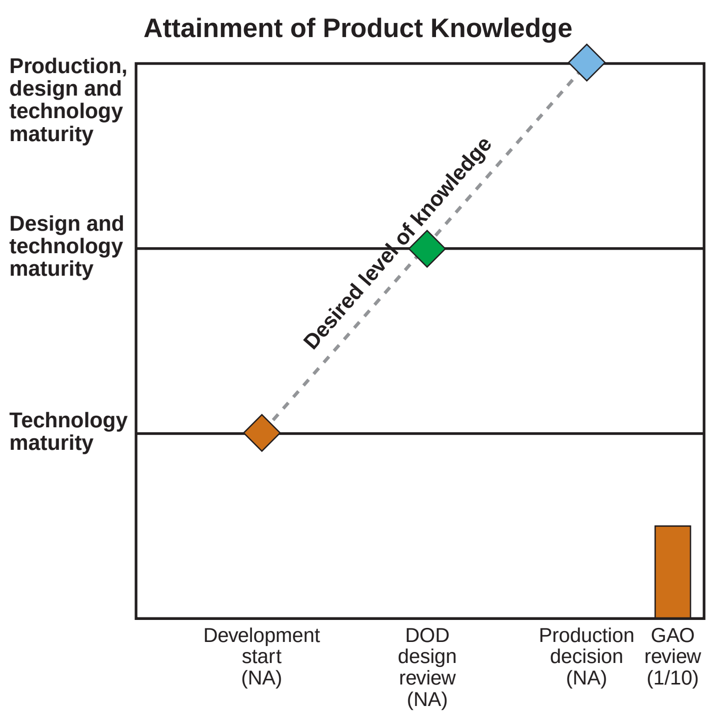
Prime contractor: Boeing
Program office: Kirtland AFB, NM
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 05/2009	Percent change
Research and development cost	NA	$5,789.1	NA
Procurement cost	NA	$0.0	NA
Total program cost	NA	$5,789.1	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns only include costs from the program's inception through fiscal year 2010.

In 2009, long-standing technical problems, cost growth, and schedule delays prompted the Secretary of Defense to recommend decreasing the fiscal year 2010 budget request for ABL by more than $200 million, cancelling the planned second aircraft, and focusing the program on technology development efforts. None of ABL's seven critical technologies are fully mature. Program officials plan to demonstrate the prototype's critical technologies during a flight test planned to occur during the second quarter of fiscal year 2010. The program has continued to experience cost increases and schedule delays as a result of technical problems such as system optics issues. The program currently estimates that the cost of the ABL through the first lethality demonstration is nearly $5.1 billion, almost five times the approximate $1 billion estimated for the original contract in 1996.



ABL Program

Technology Maturity

None of ABL's seven critical technologies are fully mature. Program officials assessed one of ABL's seven critical technologies—managing the high-power beam—as fully mature, but the technology has not yet been demonstrated in a flight environment. The remaining six technologies—the six-module laser, missile tracking, atmospheric compensation, transmissive optics, optical coatings, and jitter control—were assessed as nearing maturity. The program plans to demonstrate all critical technologies in a lethality demonstration in fiscal year 2010. During the demonstration, the ABL will attempt to shoot down a ballistic missile. The program plans to conduct an additional lethality demonstration in 2010. According to program officials, the additional lethality attempt will be used to demonstrate the capability of the ABL prototype if the first attempt is unsuccessful or to prove that the demonstration can be repeated successfully and that the ABL capability is effective.

The first lethality demonstration was delayed from the fourth quarter of fiscal year 2009 to the first quarter of fiscal year 2010 due to technical problems with the system's optics. In addition, in October 2009, MDA announced that the combination of test dynamics, continued refinement and testing, target preparation, and test range availability would delay the demonstration even further—until the second quarter of fiscal year 2010. In fiscal year 2009, the program discovered problems with the system's optics during ground testing that caused the laser to shut down prematurely. In order to rectify this issue, the program replaced the optics using a new material and tested the system in November 2009 to validate the replacement material's performance. The new material allowed the program to successfully complete ground testing.

Although program officials assessed jitter control as nearing maturity, this technology continues to be a risk for the ABL. This technology controls and stabilizes the high-energy laser beam so that aircraft vibration does not degrade the laser's aimpoint. Controlling jitter is critical to the system imparting sufficient energy on the target to rupture its fuel tank. If it is not controlled, the ABL may not be able to successfully demonstrate lethality. During fiscal year 2009, program officials lowered the risk of jitter from high to medium because ground tests verified the alignment of the laser's beam and demonstrated the system's ability to control jitter. Program officials stated that jitter performance, as measured during testing, was sufficient to support a successful lethality demonstration. However, if Congress decides to proceed with the ABL beyond its technology demonstration, jitter would have to be substantially reduced for an operational system.

Other Program Issues

In April 2009, the Secretary of Defense proposed to cancel the purchase and development of a second ABL aircraft and focus the program's research and development efforts on resolving the technology problems with the ABL prototype. MDA had planned to begin developing a second aircraft in 2010 that would have provided the initial operational capability for the ABL. This aircraft was intended to be more robust, supportable, and producible than the testing prototype and suitable for operational testing. However, technological problems with the first prototype need to be resolved before proceeding with a more advanced version.

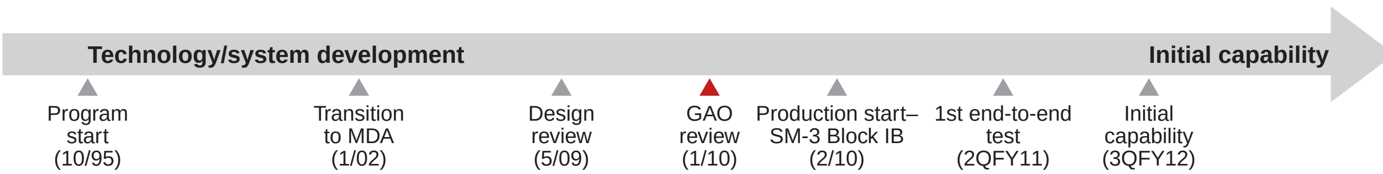
Program Office Comments

The program office provided technical comments, which were incorporated as appropriate. The ABL Program Manager also stated that the program is developing, integrating, and testing unique capabilities to defend against ballistic missile threats by acquiring, tracking, and destroying adversary missiles with the only airborne megawatt-class laser in the world. He noted that the ABL has demonstrated precision tracking and atmospheric beam compensation during flight over two dozen times from fiscal year 2007 to fiscal year 2009—including successfully tracking two boosting missiles in June 2009 and engaging a low-power instrumented boosting missile test asset in August 2009. He further noted that the first high-powered lasing through the entire beam control system and external to the aircraft in flight was achieved in December 2009, significantly reducing program technical risk. The first shootdown against a short-range, liquid fueled, foreign-acquired target is scheduled for early 2010. He noted that after this demonstration, ABL will continue testing its capability against different missiles at greater ranges and varying geometries to characterize ABL's capabilities for missile defense and that further jitter reductions will be a focus of the follow-on development in order to improve capability.

BMDS Aegis Ballistic Missile Defense

MDA's Aegis BMD is a sea-based missile defense system being developed in incremental, capability-based blocks to defend against ballistic missiles of all ranges. Key components include the shipboard SPY-1 radar, Standard Missile 3 (SM-3) missiles, and command and control systems. It will also be used as a forward-deployed sensor for surveillance and tracking of ballistic missiles. The SM-3 missile has multiple versions in development or production: Blocks IA, IB, and IIA. We assessed the SM-3 Block IB.

Source: Aegis BMD Project Office.



Program Essentials

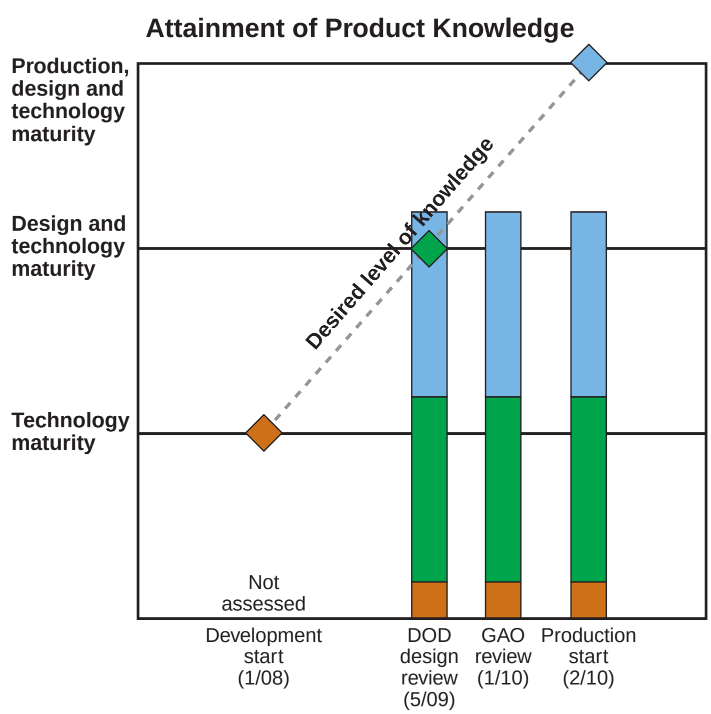
Prime contractor: Lockheed Martin (WS), Raytheon (SM-3)
Program office: Dahlgren, VA
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 05/2009	Percent change
Research and development cost	NA	$9,006.4	NA
Procurement cost	NA	$226.1	NA
Total program cost	NA	$9,232.5	NA
Program unit cost	NA	N/A	NA
Total quantities	NA	N/A	NA
Acquisition cycle time (months)	NA	N/A	NA

Columns include costs for the entire Aegis BMD program only from it's inception through fiscal year 2010. Totals do not include sustainment funds.

The Aegis BMD program is putting the SM-3 Block IB at risk for cost growth and schedule delays by planning to begin manufacturing in 2010 before its critical technologies have been demonstrated in a realistic environment. Program officials assessed three critical technologies as nearing maturity and two others as fully mature; however, four of the five have not completed developmental testing. The first flight test with a target intercept will help demonstrate that the system will work as intended, but it has been delayed until fiscal year 2011. The program reported that 100 percent of drawings were released to manufacturing, indicating that the design is stable, although design changes may be needed if problems are discovered in testing. We could not assess production maturity because the program has not started to collect production data on the SM-3 Block IB.



Aegis BMD Program

Technology Maturity

The Aegis BMD program is putting the SM-3 Block IB at risk for cost growth and schedule delays by planning to begin manufacturing in 2010 before its critical technologies have been demonstrated in a realistic environment. This risk has been deemed acceptable by the MDA. While Aegis program officials consider two technologies to be fully mature and three to be nearing maturity, we assessed four of those five technologies as immature. Prototypes of these four critical technologies—the throttleable divert and attitude control system, all reflective optics, two-color seeker, and kinetic warhead advanced signal processor—have not completed developmental testing in a relevant environment. Aegis program officials told us that the integrated ground test would not be completed until late 2010. In addition, the first target intercept flight test will not occur until the second quarter of fiscal year 2011.

Design Maturity

Program officials reported that 100 percent of SM-3 Block IB drawings were released to manufacturing. However, since most of the critical technologies have not completed developmental testing, additional design changes and costly rework could be necessary if problems are discovered.

Production Maturity

The Aegis program intends to proceed with production of 18 operationally configured Block IB rounds for testing or fielding in the second quarter of 2010 before flight testing a fully integrated prototype in an operational environment.This increases the risk of design changes and costly rework while production is underway. The first target intercept flight test will help demonstrate that the system will work as intended and in a reliable manner, but it has been delayed until the second quarter of fiscal year 2011. Program officials consider moving forward with SM-3 Block IB production before a fully integrated prototype is tested to be an acceptable risk because of the SM-3 Block IB's success in developmental testing and the program office's confidence in the throttleable divert and attitude control system design. In addition, in order to avoid a break in the combined SM-3 IA/IB missile production, long lead items must be ordered about 30 months before delivery. We could not assess the maturity of the SM-3 Block IB's production processes because the program has not started to collect production data. The program has identified 26 critical manufacturing processes—an important first step for assessing maturity—and intends to conduct a detailed analysis of process control data before the manufacturing readiness review in December 2010.

Other Program Issues

The Aegis program is developing an SM-3 Block IIA missile under a cooperative agreement with the government of Japan. The Block IIA missile is intended to be faster and have an advanced discrimination seeker. The Aegis program completed the system design review for the Block IIA in fiscal year 2009 after a delay of over 5 months. The first operational test of the Block IIA is planned for the third quarter of fiscal year 2014.

Program Office Comments

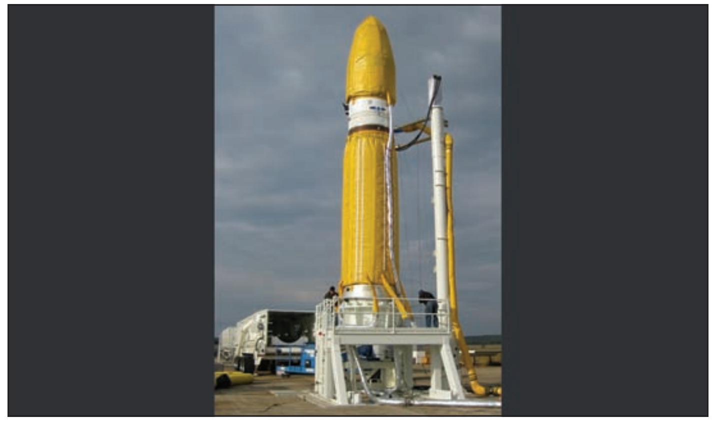
In commenting on a draft of this assessment, Aegis BMD program officials disagreed with GAO's assertion that the SM-3 Block IB missile is at risk of cost growth and schedule delays by beginning production in 2010. Program officials stated that the SM-3 Block IB full rate production decision is scheduled for 2012—after several flight tests. The procurement that is mentioned in this report is for test rounds to conduct developmental and operational flight testing. These rounds may also be deployed if a security situation demands, and any remaining rounds will support fleet proficiency firings.

GAO Response

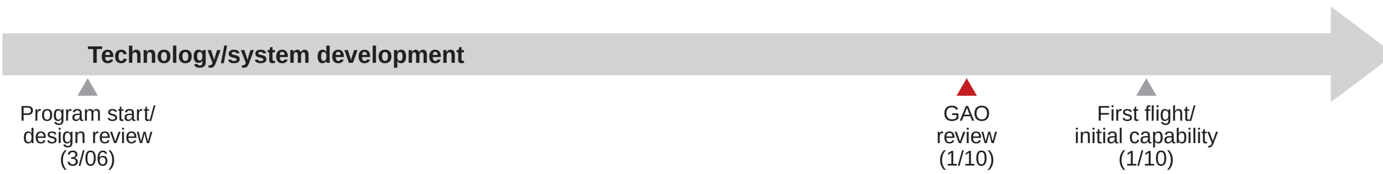
The program office acknowledges that the initial 18 SM-3 Block IBs could be deployed if needed, indicating that they may be used as operational fleet assets. Furthermore, according to MDA's September 2009 SM-3 Block IB utilization plan, 2 missiles are to be used for flight tests, 10 are to be used for fleet deployment and 6 are to be used for either fleet proficiency or deployment. The program office acknowledged that the technologies will not be fully mature until after the decision to produce these 18 SM-3s, which puts the program at risk for costly design changes and retrofits if testing reveals issues.

BMDS Flexible Target Family

MDA's Flexible Target Family (FTF) was originally designed to be a family of short, medium, and long-range targets designed with common components for ground, air, and sea launch capabilities. MDA cancelled work on all FTF target vehicles except the 72-inch, long-range LV-2 ground-launched target and is pursuing an alternative target acquisition strategy for other classes of missiles needed for Ballistic Missile Defense System (BMDS) testing. The LV-2 has 12 possible configurations that can be used to support different test events.



Source: Strategic Targets and Countermeasures Program Office.



Program Essentials

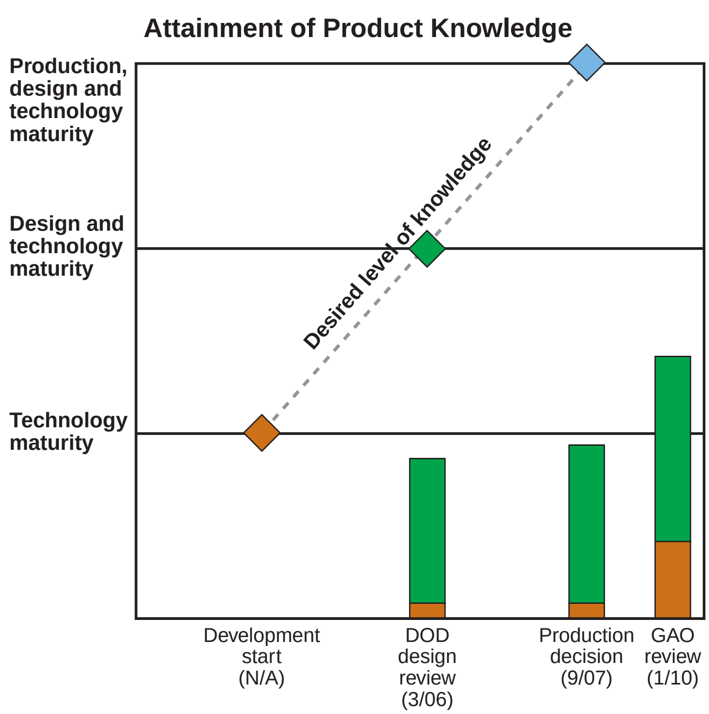
Prime contractor: Lockheed Martin
Program office: Redstone Arsenal AL
Funding FY10-FY12:
- R&D: $174.4 million
- Procurement: $0.0 million
- Total funding: $174.4 million
- Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 01/2010	Percent change
Research and development cost	$0.0	$630.9	NA
Procurement cost	$0.0	$0.0	NA
Total program cost	NA	$630.9	NA
Program unit cost	NA	$105.150	NA
Total quantities	NA	6	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include cost from program inception through FY12. FY11-12 funding is reflected from the 2009 President's Budget with adjustments.

LV-2 development issues have contributed to cost increases and schedule delays for the FTF program and flight test delays for the Aegis BMD and GMD programs. Five of the LV-2 target's six critical technologies are nearing maturity and one is immature. While most of the missile's components have been flown in legacy systems, many have been modified for the LV-2 and have not been flown together. MDA chose not to conduct a risk reduction flight of the LV-2. Instead, the program planned to mature LV-2 technologies through a BMDS flight test as early as 2008. However, qualification, safety, and modeling and simulation issues have delayed the first launch to fiscal year 2010. The LV-2's design appears stable, but ongoing technology maturation efforts and testing of new configurations could lead to design changes. Development and production costs of the first four LV-2s have grown 48 percent.



FTF Program

Technology Maturity

None of the LV-2's six critical technologies are fully mature, even through the missile is in production. Five of the LV-2's critical technologies—the reentry vehicle separation system and countermeasure integration, the avionics software, avionics suite, and C4 booster—are nearing maturity but have not been flight tested in their current form, fit, and function on the LV-2. The program planned to mature technologies through a BMDS flight test as early as 2008, but the first launch has now been delayed until fiscal year 2010. In addition, the reentry vehicle shroud is still immature. Program officials discovered problems with the design of the shrouded configuration and considered developing a back-up technology as an alternative. In late 2008, however, officials determined that problems with the original design were manageable and would not affect mission objectives. This technology will not be needed until the LV-2 target's third launch in a STSS program test now scheduled for the third quarter of fiscal year 2011. Program officials expect it to be nearing maturity by that time. The LV-2 target began development in March 2006 with almost all of its technologies still being demonstrated in a lab or through analytical studies—a low level of maturity.

Design Maturity

The design of the LV-2 target configuration for the first two missions appears stable, and the program has released 100 percent of the engineering drawings to manufacturing. Program officials reported that drawings for portions of other configurations have been released, but they are not complete. The prime contractor plans to begin work on drawings for the third and fourth missions soon, but requirements for those missions have not been finalized. Ongoing efforts to flight test the new configurations may lead to additional modifications to the target's design.

Production Maturity

We did not assess production maturity because the program does not have statistical process control data on the LV-2 target's critical manufacturing processes. Instead, the program assesses production maturity by tracking various metrics including schedule performance, number of test flags per specific procedure, number of software issues per mission test run, and others. The prime contractor has completed production of the first LV-2 vehicle and is finishing assembly and integration of the next three. The program has contracted to buy six LV-2 targets through fiscal year 2012.

Other Program Issues

LV-2 development issues have contributed to cost increases and schedule delays for both the Aegis BMD and GMD programs. MDA originally planned to launch the first LV-2 target as early as July 2008. Qualification issues, unmet safety requirements, and lack of system level modeling data have caused the first test date to move into fiscal year 2010. In addition, the development and production cost of the first four LV-2s has grown 48 percent, from $245 million to $362 million. MDA has also exercised integration and launch options on the contract bringing the total cost of the first four LV-2 targets to $435 million.

Program Office Comments

Program officials stated that the LV-2 technologies are all nearing maturity. The drawings required to shoot the first LV-2 including Ground Support Equipment drawings are complete and the shrouded configuration design has been completed and is ready for demonstration in flight test. Officials stated that requirements for the first four missions are either complete or near completion. For those missions (numbers 2 and 3) with draft requirements, the documentation is of sufficient detail to allow the contractor to develop mission-specific simulations and target configuration alterations. They stated that the formal draft requirements documents were issued for these missions in the first quarter fiscal year 2010. Unit cost (recurring costs) for the six LV-2 targets averages approximately $30.3 million for the target and unique mission applications.

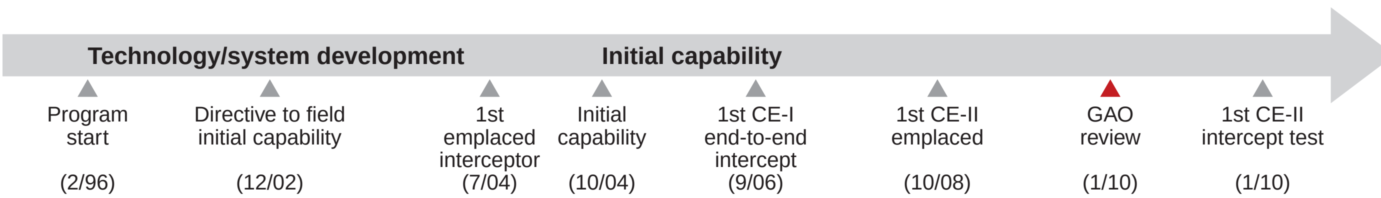
GAO Response

In our review, we found that unit cost was estimated in several ways by different organizations. The Defense Contract Management Agency (DCMA), for example, estimates that the recurring unit cost for the LV-2 is $55 million—significantly higher than MDA's estimate. Regardless, the total program cost calculated by both MDA and DCMA is consistently around $630 million for 6 LV-2s, which brings the total unit cost of each target to $105 million. In addition, DCMA officials explained that these calculations were based on December 2008 data. Subsequently, launch delays occurred, so the cost could be higher.

BMDS Ground-Based Midcourse Defense (GMD)

MDA's GMD is being fielded to defend against limited long-range ballistic missile attacks during the midcourse phase of flight. GMD consists of an interceptor—a booster with an exoatmospheric kill vehicle (EKV) on top—and a fire control system that formulates battle plans and directs components that are integrated with BMDS radars. We assessed the maturity of all critical technologies and the design maturity of the EKV's upgraded configuration known as Capability Enhancement II (CE-II).

Source: Department of Defense.



Program Essentials

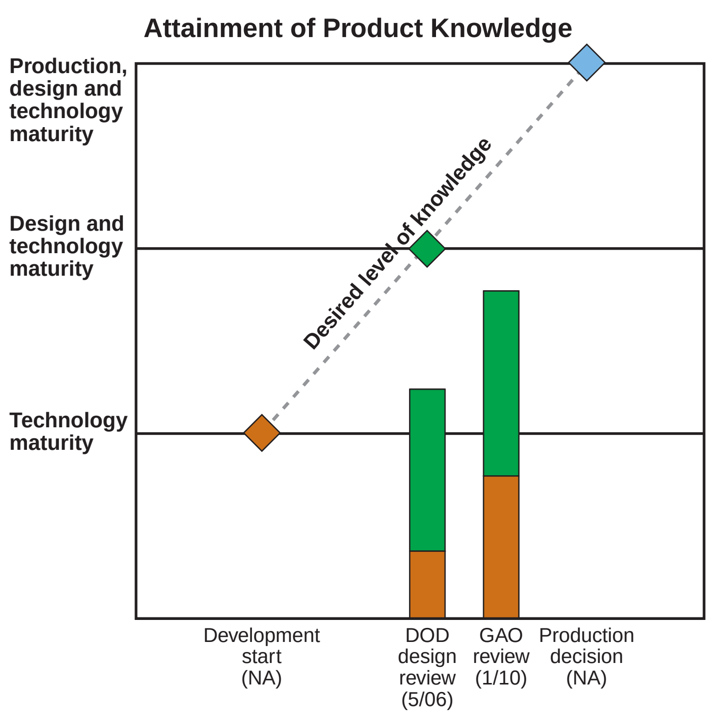
Prime contractor: Boeing Company
Program office: Redstone Arsenal, AL
Funding FY10-FY13:
R&D: $1,882.8 million
Procurement: $0.0 million
Total funding: $1,882.8 million
Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 09/2009	Percent change
Research and development cost	NA	$32,934.7	NA
Procurement cost	NA	$0.0	NA
Total program cost	NA	$33,129.7	NA
Program unit cost	NA	N/A	NA
Total quantities	NA	N/A	NA
Acquisition cycle time (months)	NA	N/A	NA

Columns include cost from program inception through FY13. FY11-13 funding is from the 2009 President's Budget with adjustments. Totals do not include the future cost of the European component.

MDA continues to put the GMD program at risk for cost growth and schedule delays by buying and emplacing enhanced interceptors before this configuration has been demonstrated in a realistic environment. MDA planned to test the CE-II EKV in fiscal year 2009, but this test has been delayed several times and is now scheduled for fiscal year 2010. However, by the time this test is conducted, program officials state that almost 40 percent of the CE-II EKVs will have been delivered. Additionally, two components—the Inertial Measurement Unit and Electronics Unit—are experiencing problems during development. While all the drawings for the CE-II EKV have been released, costly design changes and rework could be necessary if issues are discovered during flight testing. MDA has also continued to produce hardware for operational use, yet it does not intend to make a formal production decision.



GMD Program

Technology Maturity

MDA continues to put the GMD program at risk for further cost growth and delays by buying and emplacing enhanced interceptors before the critical technologies have been demonstrated in a realistic environment. While all nine technologies in the operational GMD configuration are mature, two technologies being developed for the CE-II EKV—an upgraded infrared seeker and onboard discrimination—are not fully mature. The GMD program expected to integrate these technologies and emplace enhanced interceptors in fiscal year 2008, but the program was not able to do so because of problems with the inertial measurement unit and electronics unit. These problems have slowed planned deliveries of the CE-II EKVs, and as a result, MDA was only able to emplace 28 of the 33 interceptors planned through fiscal year 2009. Work on these components has also been the primary driver of GMD cost growth in fiscal year 2009.

Design Maturity

While all the drawings for the CE-II EKV have been released and the design appears stable, costly design changes and rework could still be necessary since this configuration has not been flight tested. Since the preliminary design review in August 2005 and critical design review in August 2006, problems discovered during EKV testing have already resulted in significant redesigns of the CE-II.

Production Maturity

We did not assess production maturity. While the program is buying interceptors for operational use, officials do not plan to make an official production decision or collect statistical control data because the planned quantities are small. However, GMD continues to concurrently develop, manufacture, and field CE-II EKVs before they are fully demonstrated through testing. The GMD program office projects that the contractor will deliver about 40 percent of the CE-II EKVs currently on contract before the first flight test demonstrates this configuration.

Other Program Issues

GMD's flight test program continues to experience setbacks and delays, which impedes realistic evaluation of GMD's capability. Since 2005, GMD has only conducted three intercept tests. In fiscal year 2009, two intercept tests were planned; however, the program only partially completed one. The test, FTG-05 in December 2008, achieved a successful intercept, but the target did not deploy its countermeasures, reducing the complexity of the test. According to program officials, the target failure initially caused the GMD program to delay the second flight test until the fourth quarter of fiscal year 2009. However, problems with the target and sea-based X-band radar in pretest activities have further delayed the test until fiscal year 2010. This flight test will be the first one with the CE-II EKV, even though interceptors with this configuration are already emplaced.

The GMD program is continuing a scheduled refurbishment effort for emplaced interceptors to address parts reliability issues in the booster and kill vehicle. The total expected cost of the refurbishment effort is still unknown because, according to program officials, the program is expanding to address longer-term sustainment activities, including determining what is required for mid-life maintenance of a GBI and increasing the refurbishment scope to include known Exo-atmospheric Kill Vehicle items previously not part of the initial limited refurbishment concept. In addition, as MDA continues to manufacture GBIs, they are discovering additional process and design concerns, and corrective actions are being incorporated into the refurbishment program as intended to increase the reliability of the fleet. Additionally, in cases that require extensive levels of refurbishment, MDA is expecting the work to cost between $14 million and $24 million per unit. GMD is also developing an interceptor rotation program. GMD will replace the oldest emplaced interceptors with newly manufactured ones to reduce the fleet's age. The removed interceptors will be modified into testing assets or utilized as operational spares. The projected cost of this effort is $24 million for each operational refurbishment and $30 million for each interceptor refurbished and modified for flight tests.

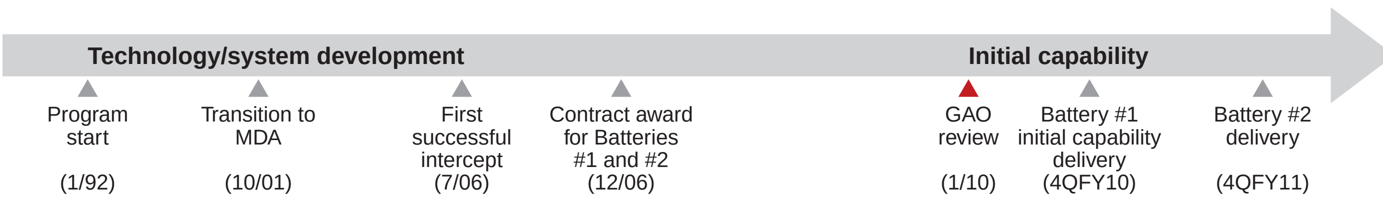
Program Office Comments

GMD provided technical comments, which we incorporated as appropriate.

BMDS Terminal High Altitude Area Defense (THAAD)

MDA's THAAD is being developed as a rapidly-deployable, ground-based missile defense system with the capability to defend against short- and medium-range ballistic missiles during their late midcourse and terminal phases. A THAAD battery includes interceptor missiles, a launcher, an X-band radar, and a fire control and communications system. We assessed the THAAD batteries that MDA plans to deliver to the Army in fiscal years 2010 and 2011 for initial operational use.

Source: THAAD Project Office/MDA, Release.



Program Essentials

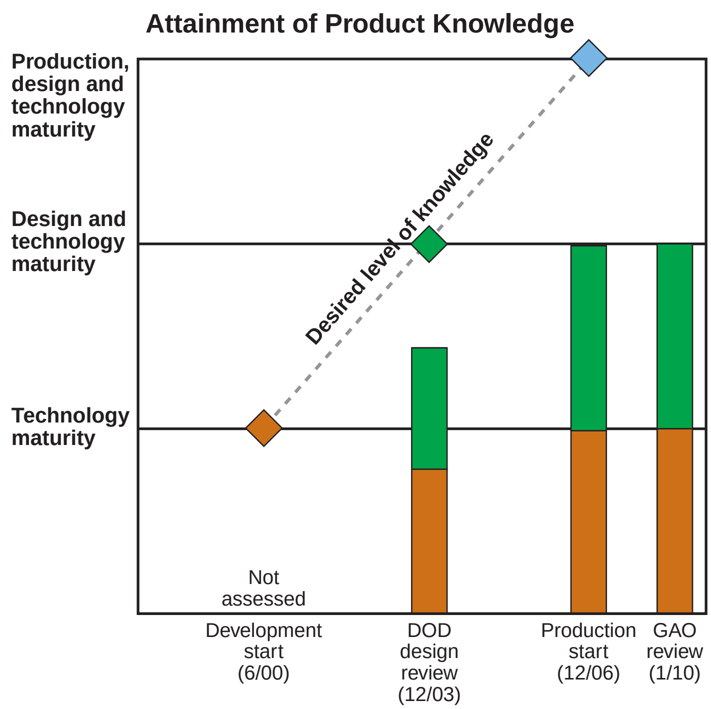
Prime contractor: Lockheed Martin
Program office: Huntsville, AL
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 05/2009	Percent change
Research and development cost	NA	$13,955.7	NA
Procurement cost	NA	$526.1	NA
Total program cost	NA	$14,481.8	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs from the program's inception through fiscal year 2010. Totals do not include sustainment funds.

The THAAD program is producing assets for initial operational use. The program's critical technologies are mature and its design appears stable. However, it is still qualifying components and conducting flight tests, so additional design work may be necessary. Target issues continue to affect the program as it was unable to conduct two planned fiscal year 2009 flight tests or its first fiscal year 2010 flight test because of target issues. Although one successful intercept test during fiscal year 2009 could not demonstrate a major knowledge point because of target availability, as THAAD's first developmental and operational test it demonstrated THAAD's ability to launch two interceptors against a single target. The program is on schedule to deliver two THAAD batteries to the Army in 2010 and 2011. DOD requested procurement funding for fiscal year 2010 to procure an additional battery.



THAAD Program

Technology and Design Maturity

The program's four major components—the fire control and communications component, the interceptor, the launcher, and radar—are mature, and the system's design appears stable with 99 percent of its design drawings released. However, the number of drawings has increased in the past year after the program held design reviews for several components, including the prime power unit in the radar. Additional drawings or design work could still be required based on the results of remaining ground and flight testing.

Production Maturity

MDA awarded a contract in December 2006 for two operational batteries without fully testing all the systems critical components, which could lead to costly design changes and rework. While we could not assess THAAD's production maturity because the program has not collected process control data on its key production processes, the THAAD program does monitor its manufacturing processes by tracking metrics related to production readiness, configuration changes, parts shortages, and product progression through final assembly. Based on the program's own assessment of these metrics, it has identified a number of risks, including beginning production before fully qualifying critical components. The first THAAD battery will be provided to the Army and fielded in fiscal year 2010 with the second battery to follow in fiscal year 2011.

Other Program Issues

Target issues have continued to affect the THAAD program. The program was unable to conduct either of its planned tests (FTT-11 and FTT-12) in fiscal year 2009 due to target availability issues and an agency-wide restructuring of its testing schedule. As a result, both of the planned flight tests for fiscal year 2009 were delayed into fiscal year 2010. The first flight test to be conducted in fiscal year 2010, FTT-11, resulted in a “no test” due to target failure. This test was supposed to have demonstrated THAAD's ability to intercept a real, complex target from among multiple simulated targets. The second test plans to demonstrate THAAD's ability to engage two targets for the first time. The program did successfully conduct an intercept flight test in 2009 that had been rescheduled from fiscal year 2008 due to a target failure. This test was THAAD's first developmental and operational test event and demonstrated the system's ability to launch two interceptors against one target for the first time. This test was originally designed to be the first intercept of a medium range ballistic missile, a major knowledge point for the program, but because the medium-range target was not available, the program used a short-range target instead. The program will not attempt a medium-range ballistic missile intercept until fiscal year 2011—–nearly 3 years later than planned.

In its fiscal year 2010 budget, DOD requested procurement funding for THAAD for the first time. DOD requested $420 million in procurement funding to buy interceptors, launchers, and a fire control and communication system for a future THAAD battery, as well as to procure tooling and equipment to increase THAAD interceptor production capacity. Program officials told us that they plan to award a procurement contract for a future THAAD battery by the end of fiscal year 2010. These batteries will be fully funded using procurement funds. The first two THAAD batteries were incrementally funded using research, development, test and evaluation funds as authorized by Congress.

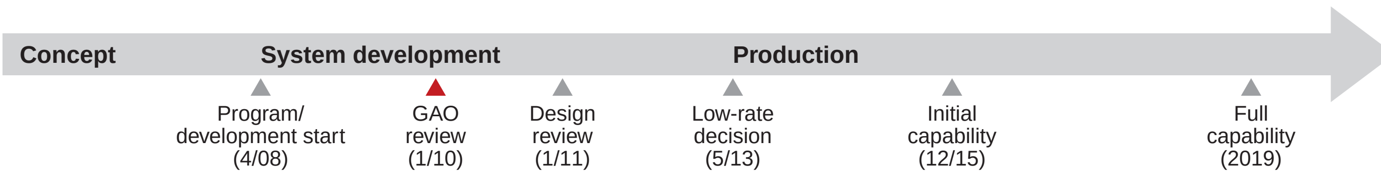
Program Office Comments

In commenting on a draft of this assessment, the THAAD program manager noted that THAAD has successfully demonstrated the element's ability to destroy ballistic missile threats in six successful flight tests including its most recent successful intercept attempt in March 2009. Additionally, he stated that THAAD is continuing to conduct ground testing and operational testing to further demonstrate the THAAD system's capability and reliability for missile defense. The THAAD program also provided technical comments, which were incorporated where appropriate.

Broad Area Maritime Surveillance Unmanned Aircraft System

The Navy's Broad Area Maritime Surveillance Unmanned Aircraft System (BAMS UAS) is intended to provide a persistent maritime intelligence, surveillance, and reconnaissance (ISR) capability. Along with the P-8A Poseidon and the future EP-X electronic surveillance aircraft, BAMS UAS will be part of a maritime patrol and reconnaissance family of systems that recapitalizes the Navy's airborne ISR assets. Future increments are planned to upgrade communication relay capabilities and add signals intelligence capability.

Source: PMA-262.



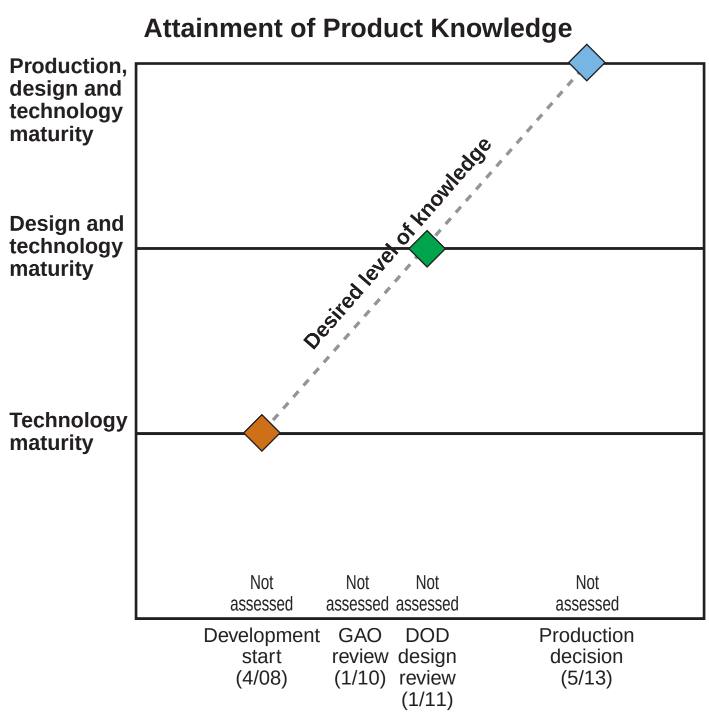
Program Essentials

Prime contractor: Northrop Grumman Systems Corporation
Program office: Patuxent River MD
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 04/2008	Latest 07/2009	Percent change
Research and development cost	$3,064.1	$3,064.1	0.0
Procurement cost	$9,094.0	$9,094.0	0.0
Total program cost	$12,531.2	$12,531.2	0.0
Program unit cost	$179.017	$179.017	0.0
Total quantities	70	70	0.0
Acquisition cycle time (months)	92	92	0.0

According to DOD and the Navy, the BAMS UAS program began system development in August 2008 with all its technologies approaching maturity. However, that assessment may understate the program's technology and integration risks. The BAMS UAS program has identified six watch items that could affect cost, schedule, and performance. Several of these watch items, including the multi-spectral targeting system, are used on UAS platforms such as the Air Force's Reaper and are tracked as critical technologies. BAMS UAS has completed several systems engineering reviews including its system requirement and system functional reviews. A preliminary design review is scheduled for January 2010. An additional technology readiness assessment will be conducted after the preliminary design review. BAMS UAS is scheduled to reach initial operational capability in December 2015.



BAMS UAS Program

Technology Maturity

DOD and the Navy have certified that all BAMS UAS technologies were approaching maturity and had been demonstrated in a relevant environment before the start of system development. While the program office does not currently identify any technologies as critical, the program is still managing various technology and integration risks. Specifically, the program is monitoring six watch items that may cause cost, schedule, and performance issues during development. These include radar software and the multi-spectral targeting system's large array and focus integration. The Air Force's Reaper UAS program also uses the multi-spectral targeting system, but tracks it as a critical technology.

There are other technologies that are essential for meeting BAMS UAS key performance parameters that the Navy did not identify as critical. Several of these technologies have been tracked as mature critical technologies on Air Force UAS programs. For example, both the Global Hawk and BAMS UAS programs use electro-optical and infrared sensors, which must be operational to meet key performance parameters. While the Global Hawk program tracks its sensors as critical technologies, BAMS UAS does not. These decisions will be reviewed when the Navy conducts an additional independent technology readiness assessment and submits it to DOD for review after the program's January 2010 preliminary design review.

The BAMS UAS will utilize more than 5 million lines of software code, including the development of more than 600,000 lines of new code. According to the program, the software development effort is closely monitored and is being developed in three blocks of capability to decrease risks.

Other Program Issues

BAMS UAS is intended to serve as an adjunct to the P-8A Poseidon. The Navy intends to position BAMS UAS mission crews with maritime patrol and reconnaissance forces personnel to allow operators to closely coordinate missions and utilize a common support infrastructure. According to program officials, BAMS UAS plans to achieve full operating capability in 2019, which aligns with the full operational capability for the P-8A.

In 2009, the Undersecretary of Defense for Acquisition, Technology and Logistics issued an acquisition decision memorandum which called for ground station commonality between UAS platforms. According to BAMS UAS officials, the Navy is coordinating with the Air Force to identify common approaches and share planned capabilities for the BAMS UAS ground station. Program officials also indicated a Memorandum of Agreement (MOA) has been put in place between the Navy and Air Force to formalize cooperation on all potential joint program areas.

The BAMS UAS program is continuing to gain knowledge about the performance and capabilities from the BAMS Demonstrator program. The BAMS Demonstrator consists of two block 10 Global Hawk UASs and is being used to support BAMS UAS design activity and to develop a Navy doctrine and concept of operations for the system.

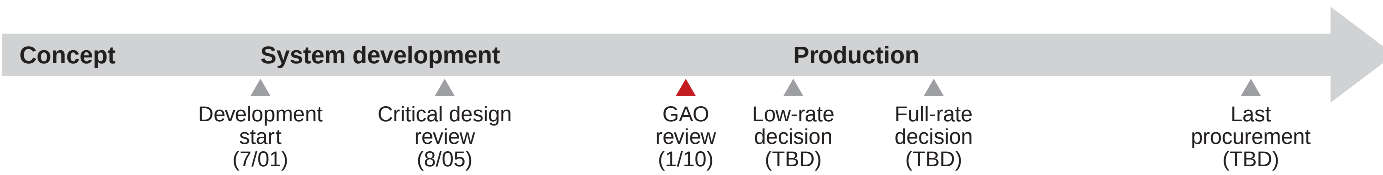
Program Office Comments

The BAMS UAS program office did not agree with the depiction of the program's assignment and management of critical technologies in a draft of this assessment. The program office indicated that the program's technology readiness and maturity were assessed by an independent panel and validated by DOD prior to development start in accordance with DOD policies. In addition, the program noted that BAMS UAS does not currently have any critical technology elements, but the panel identified six technology readiness assessment watch items that are managed, tracked, and assessed for risk potential. The watch items are not at the subsystem level but assessed on particular attributes. The six identified watch items are the following: Multi-Spectral Targeting System (MTS-B) (Large array optics and auto-focus integration), Multi-Function Active Sensor (MFAS) Rotary Joint, Due Regard Radar (Software), Automatic Dependent Surveillance Broadcast (ADS-B) Contact Report to Track Assignment, On-Board Image Formatting, Compression and Reduction, and Smart Image bandwidth Management.

C-130 Avionics Modernization Program

The Air Force's C-130 AMP will standardize the cockpit and avionics to increase the reliability, maintainability, and sustainability for three combat configurations of the C-130 fleet. The program is intended to ensure the C-130 global access and deployability by satisfying navigation and safety requirements, installing upgrades to the cockpit systems, and replacing many systems no longer supportable due to diminishing manufacturing resources.

Source: C-130 Avionics Modernization Program.



Program Essentials

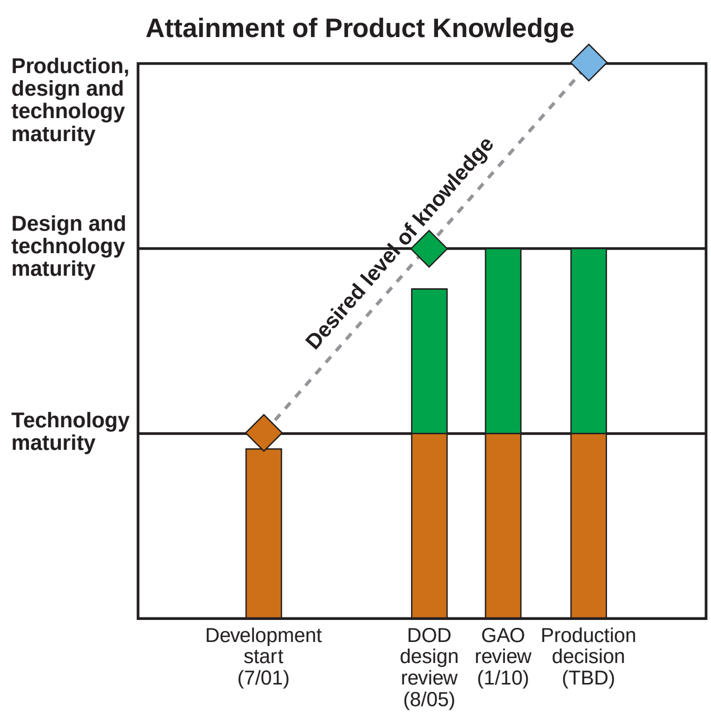
Prime contractor: Boeing
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 07/2001	Latest 07/2009	Percent change
Research and development cost	$756.4	NA	NA
Procurement cost	$3,274.5	NA	NA
Total program cost	$4,030.8	NA	NA
Program unit cost	$7.767	NA	NA
Total quantities	519	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Cost updates are pending the C-130 AMP program's production decision

While the C-130 AMP program's technologies are mature and its design is stable, the program's production decision has been delayed several times since it was restructured in 2008 following a Nunn-McCurdy unit cost breach of the critical threshold. The reasons for the delays include concerns over the program's acquisition strategy and affordability, and software testing and documentation issues. These issues have been addressed, and program officials said that the program's production decision is tentatively planned for spring 2010. A proposed effort to provide avionics upgrades to additional C-130 aircraft will also be evaluated as part of future budget cycles.



C-130 AMP Program

Technology Maturity

The C-130 AMP program's three current critical technologies—global air traffic management, defensive systems, and combat delivery navigator removal—are mature. After a Nunn-McCurdy unit cost breach of the critical cost growth threshold, the program was restructured and the number of critical technologies was cut in half from six to three. The removed technologies were intended for Special Mission C-130 aircraft configurations, which were eliminated from the program during the restructure.

Design Maturity

The design of the C-130 AMP combat delivery configuration is stable, with all of the expected drawings releasable to manufacturing. The program is currently completing flight testing of production representative aircraft, which it plans to finish by the end of 2009. The program also plans to complete configuration reviews by the end of 2010 to ensure the modified system matches the design and meets its specifications.

Production Maturity

We could not assess production maturity because the program does not collect statistical process control data on its critical manufacturing processes. However, according to program officials, the Air Force and the contractor will use detailed, proven work instructions to control installation quality and will conduct inspections to ensure installations are performed as planned. In addition, the contractor is currently meeting or exceeding its quality goals.

Other Program Issues

Since its restructuring in 2008, the C-130 AMP program's production decision has been delayed several times. These delays have been primarily due to recent uncertainty over the future of the program due to affordability concerns, senior leadership concerns over the program's acquisition strategy, software testing issues, and completion of required documentation. These issues have been addressed, and program officials said that the program's production decision is tentatively planned for spring 2010.

The Air Force had proposed a second phase for the C-130 AMP program to provide the avionics modernization to C-130 aircraft that are not part of the 221 aircraft included in the current program. The Air Force will evaluate the requirement to modernize these aircraft as part of future budget cycles.

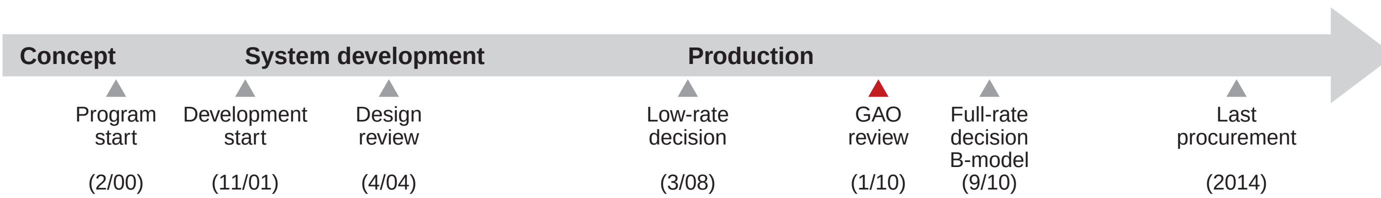
Program Office Comments

The Air Force provided technical comments on this assessment, which were incorporated where appropriate.

C-5 Reliability Enhancement and Reengining Program (C-5 RERP)

The Air Force's C-5 RERP is one of two major upgrades for the C-5. The RERP is designed to enhance the reliability, maintainability, and availability of the C-5 by replacing the propulsion system; modifying the mechanical, hydraulic, avionics, fuel, and landing gear systems; and making other structural modifications. Together with the C-5 Avionics Modernization Program (AMP), these upgrades are intended to improve C-5 mission capability rates and reduce total ownership costs. We assessed the C-5 RERP.

Source: Edwards AFB.



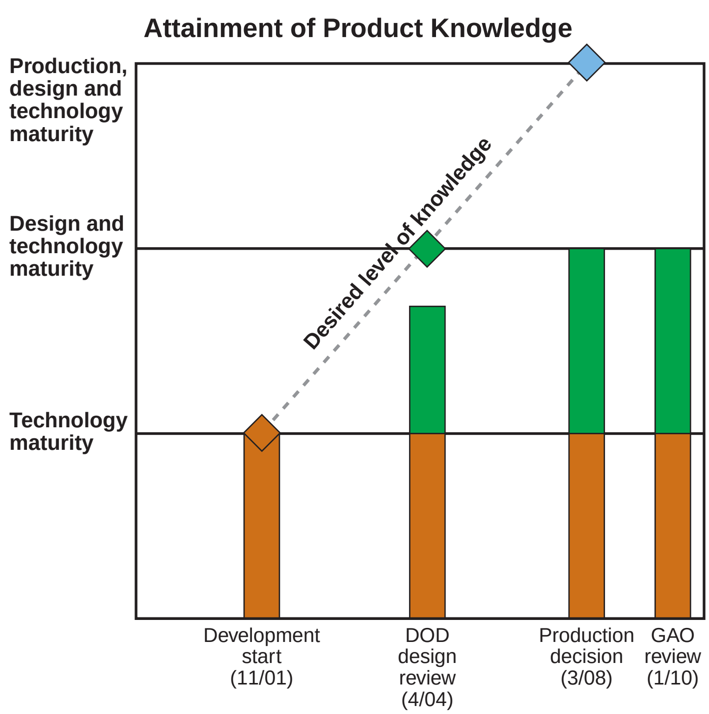
Program Essentials

Prime contractor: Lockheed Martin
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $119.5 million
- Procurement: $4,939.5 million
- Total funding: $5,067.2 million
- Procurement quantity: 45

Program Performance (fiscal year 2010 dollars in millions)

	As of 11/2001	Latest 08/2009	Percent change
Research and development cost	$1,709.5	$1,771.2	3.6
Procurement cost	$8,924.0	$5,531.2	-38.0
Total program cost	$10,637.2	$7,310.6	-31.3
Program unit cost	$84.422	$140.589	66.5
Total quantities	126	52	-58.7
Acquisition cycle time (months)	100	139	39.0

The C-5 RERP is currently in production. C-5 RERP critical technologies are mature and its design is stable. We did not assess production maturity because the Air Force is buying commercially available items. Three systems development and demonstration aircraft are currently flying missions as part of opertional test and evaluation. Qualification testing is expected to end in January 2010. The program experienced a Nunn-McCurdy unit cost increase over the critical cost growth threshold in 2007 and quantities were subsequently cut from 111 to 52 aircraft. Additional program changes could occur if the Air Force decides it cannot afford to fund production to the current cost estimate. The results of an ongoing mobility capabilities requirements study may also affect the number of C-5 aircraft receiving the RERP modification.



C-5 RERP Program

Technology and Design Maturity

According to an independent technology readiness assessment conducted in October 2001, the C-5 RERP's technologies are mature. In addition, the C-5 RERP design is stable with 100 percent of the drawings released.

Production Maturity

We did not assess the C-5 RERP's production maturity because the Air Force is buying commercially available items. According to program officials, the program office and prime contractor have expended considerable effort in preparing the RERP for production. For example, a production readiness review was conducted, three test aircraft were produced in the system development and demonstration phase, and the lessons learned from AMP are being applied to production plans.

The C-5 RERP program experienced a 30-month delay between the first flight of the last system development and demonstration aircraft in February 2007 and the start of modifying the first production aircraft in August 2009. Increased costs contributed to this delay. For example, the Lot 1 production award was delayed because upward production cost pressures associated with the engines, pylons, reliability enhancement items, and labor resulted in the program being restructured.

The Air Force did not provide a low-rate initial production aircraft for operational testing, as recommended by the Director, Operational Test and Evaluation because one will not be available until September 2010. Operational testing began in October 2009 and is expected to be completed in January 2010. Three systems development and demonstration aircraft are currently flying missions as part of operational test and evaluation.

Other Program Issues

In 2007, DOD notified Congress of a Nunn-McCurdy unit cost increase over the critical cost growth threshold. DOD considered 14 options to meet its strategic airlift requirements and concluded that the cost to upgrade all C-5 aircraft was unaffordable. DOD decided to limit RERP modifications to 52 aircraft—49 production aircraft (47 C-5Bs and 2 C-5Cs) and 3 system development and demonstration aircraft (2 C-5Bs and 1 C-5A)—rather than 111 aircraft planned. While the Air Force is expected to spend $3.4 billion less under the restructured program, ultimately, less than one-half of the aircraft will be modernized at a much higher unit cost.

Further changes to the program are possible based on whether the program exercises future contract options and the mobility capability study. Program officials have indicated that if options for lots four through seven of the C-5 RERP production contract are not exercised by the dates required in the contract, the remaining lot four through seven negotiated not to exceed prices become invalid for all future options. Consequently, officials indicated that future work may need to be renegotiated and if so, it would lead to a substantial increase in the negotiated prices. In addition, DOD is currently studying its future mobility capabilities requirements with the results expected in December 2009. The study may or may not affect the number of C-5s that require the RERP modification.

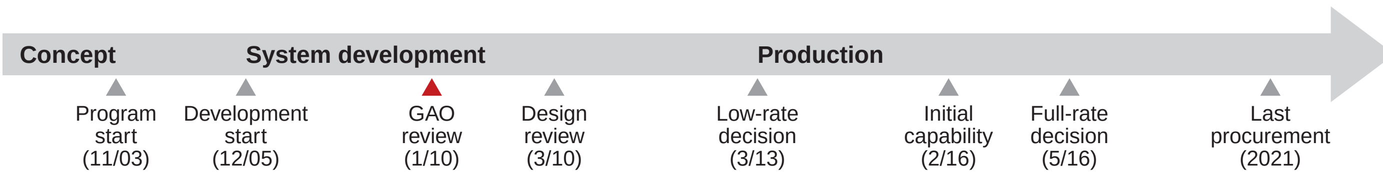
Agency Comments

The Air Force provided technical comments to a draft of this assessment, which were incorporated as appropriate.

CH-53K Heavy Lift Replacement (HLR)

The Marine Corps' CH-53K helicopter will perform heavy-lift assault transport of armored vehicles, equipment, and personnel to support distributed operations deep inland from a sea-based center of operations. The CH-53K program is expected to replace the current CH-53E helicopter with improved range and payload, survivability and force protection, reliability and maintainability, coordination with other assets, and total cost of ownership.

Source: © 2008 Sikorsky Aircraft Corporation.



Program Essentials

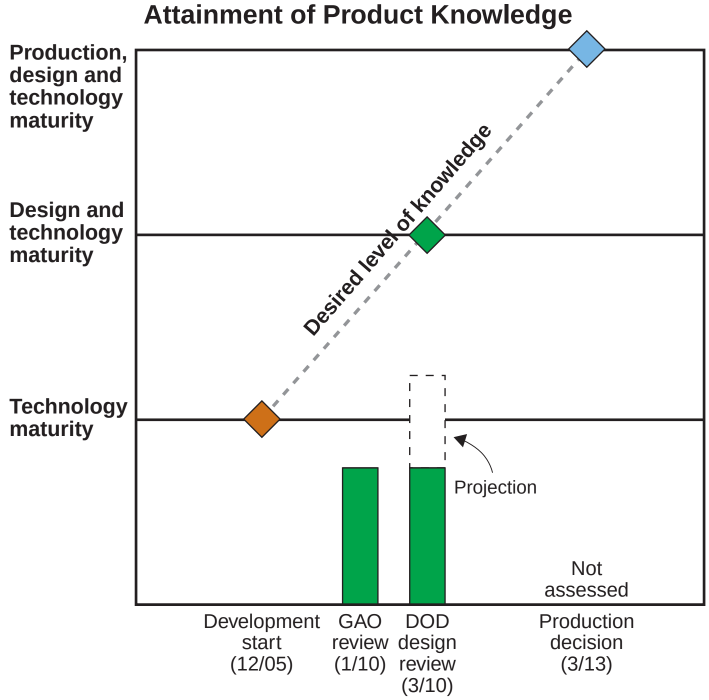
Prime contractor: Sikorsky Aircraft Corporation
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $2,862.1 million
- Procurement: $15,474.7 million
- Total funding: $18,336.8 million
- Procurement quantity: 156

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2005	Latest 08/2009	Percent change
Research and development cost	$4,270.8	$4,222.5	-1.1
Procurement cost	$11,878.9	$12,327.4	3.8
Total program cost	$16,149.7	$16,549.9	2.5
Program unit cost	$103.524	$106.089	2.5
Total quantities	156	156	0.0
Acquisition cycle time (months)	119	122	2.5

The CH-53K program is being restructured because of delays in the completion of key systems engineering tasks. The program began development without adequate knowledge of its requirements and critical technologies and underestimated the complexity of the system engineering. The CH-53K's two critical technologies, the main rotor blade and the main gearbox, were immature at development start and, according to program officials, are maturing as planned. The program expects the design to be stable with 90 percent of drawings released by March 2010. Due to attrition in the fleet of CH-53Es, the Marine Corps needs to field the CH-53Ks as soon as possible. While the program is experiencing schedule delays, the Navy still hopes to enter production in March 2013. As a result, the program will likely complete less testing before production begins.

Attainment of Product Knowledge



CH-53K Program

Technology Maturity

The CH-53K's two critical technologies, the main rotor blade and the main gearbox, were immature at development start and, according to program officials, are maturing as planned. The program office estimates that they will be fully mature by the start of low-rate initial production, currently planned for March 2013. The main rotor blade will be the same diameter (79 feet) as, and 11 percent wider than, the CH-53E design. A smaller-scale (1/7th) model of the main rotor blade has demonstrated improved performance in wind tunnel tests. The actual-sized rotor blade has not been tested because appropriately sized wind tunnels do not exist. According to program officials, full scale prototypes of main gearbox components have exceeded performance requirements in testing.

Design Maturity

The CH-53K design is approaching stability. According to the program office, about 67 percent of the CH-53K's expected drawings—11,756 out of 17,622—are releasable to manufacturing. In addition, half of the required subsystem design reviews have been completed as of October 2009. The program office expects 90 percent of the drawings to be releasable by its design review currently scheduled for March 2010.

Other Program Issues

The CH-53K program is being restructured because of delays in the completion of key systems engineering tasks and uncertainty about the cost and schedule of the program. The program has made attempts to mitigate schedule risks, including eliminating noncritical tasks and postponing preliminary and critical design review, but continues to experience delays. For example, the critical design review has been delayed multiple times and will now take place in March 2010 at the earliest—over 1 year later than originally planned. According to program officials, the critical design review will be delayed until all subsystem design reviews are successfully completed. While the program continues to mitigate schedule delays, the Navy still hopes to enter production in March 2013. As a result, the program will likely complete less testing before production begins. While concurrent testing and production may help to field the system sooner, it could also result in greater retrofit costs if unexpected design changes are required.

Delays in the CH-53K program may result in the extended use of and increased costs for legacy systems, such as the CH-53E and CH-53D helicopter. Currently deployed CH-53E aircraft are flying at three times the planned utilization rate. This operational pace is expected to result in higher airframe and component repair costs, including short-term fatigue repairs necessary to minimize CH-53E inventory reductions until CH-53K deliveries reach meaningful levels. The number of operational CH-53Es is 24 aircraft fewer than required in the Marine Corps' fiscal year 2010 aviation plan. This shortfall will increase if the planned attrition rate of two aircraft per year holds. According to program officials, all available decommissioned CH-53E helicopters have been reclaimed and they are looking into extending the serviceable life of the CH-53D, a medium lift helicopter built in the 1960s, by an additional 2 years pending an analysis of the costs.

Program Office Comments

In its comments on a draft of this assessment, the program office stated that in late 2009, the Director, Defense Research and Engineering, completed two independent assessments of the CH-53K program. These reviews, completed after GAO's assessment, verified that the program office has implemented effective corrections for previous program schedule issues and that critical technologies have matured according to plan. Budget and funding uncertainties at the time of GAO's assessment have also been corrected with finalization of the President's fiscal year 2011 budget request. These events will support a contract modification and revised acquisition program baseline in first quarter of fiscal year 2011. In its comments, the Navy also provided technical comments, which were incorporated as appropriate.

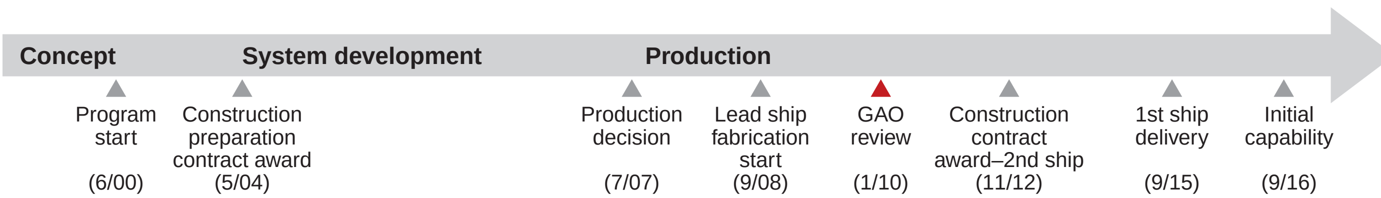
GAO Response

While the program's technologies may be maturing according to plan, the program still began without adequate knowledge of those technologies and the complexity of the systems engineering effort. According to the President's fiscal year 2011 budget request, the Navy has asked the contractor to revise the schedule to support an initial operating capability in fiscal year 2018—an almost 2-year delay.

CVN 21 Nuclear Aircraft Class Carrier

The Navy's CVN 21 program is developing a new class of nuclear-powered aircraft carriers. The new carriers are expected to include advanced technologies in propulsion, aircraft launch and recovery, and survivability designed to improve operational efficiency and enable higher sortie rates while reducing required manpower. The Navy awarded a construction preparation contract for the lead ship, CVN 78, in May 2004. Construction began in September 2008 and the Navy expects delivery of this ship by September 2015.

Source: CVN-21 Program Office 050708-D-8455H-001 Washington, D.C. (July 8, 2005) U.S. Navy graphic (released).



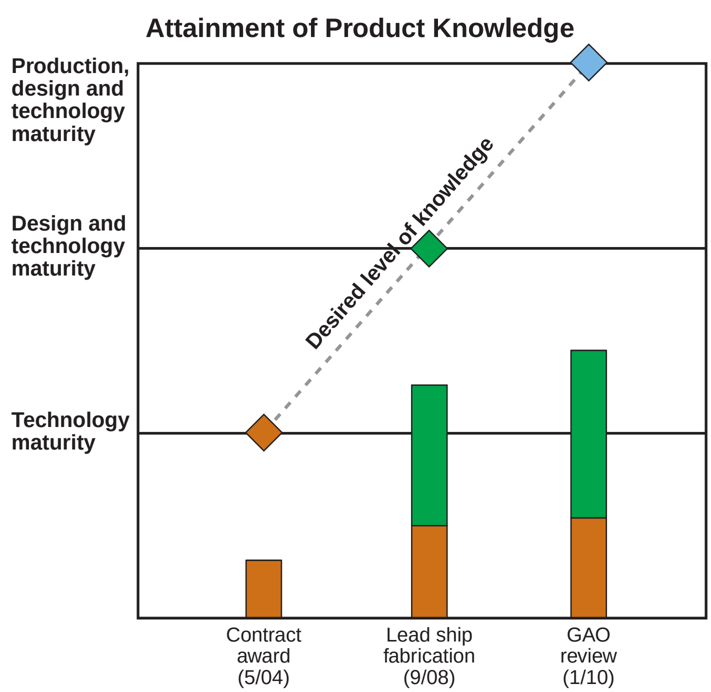
Program Essentials

Prime contractor: Northrop Grumman Shipbuilding-Newport News
Program office: Washington, DC
Funding needed to complete:
R&D: $1,200.0 million
Procurement: $17,132.8 million
Total funding: $18,332.7 million
Procurement quantity: 2

Program Performance (fiscal year 2010 dollars in millions)

	As of 04/2004	Latest 08/2009	Percent change
Research and development cost	$4,685.4	$4,458.9	-4.8
Procurement cost	$30,015.6	$26,630.7	-11.3
Total program cost	$34,701.0	$31,089.6	-10.4
Program unit cost	$11,567.001	$10,363.201	-10.4
Total quantities	3	3	0.0
Acquisition cycle time (months)	137	149	8.8

The CVN 78 began construction in September 2008 without all its critical technologies mature or a complete product model for the entire ship. Eight of the program's 13 critical technologies are still not fully mature because the technologies have not been demonstrated in a realistic environment. Of these technologies, the electromagnetic aircraft launch system (EMALS), advanced arresting gear, and dual band radar continue to present the greatest risk to the ship's cost and schedule. While the contractor has completed the ship's detail phase in the 3D product model, the program could experience costly design changes because EMALS testing is proceeding concurrently with ship construction. Construction of a number of the units low on the ship is complete. According to program office officials, these units account for about 9 percent of the ship's total production hours.



CVN 21 Program

Technology Maturity

The CVN 21 program has consistently demonstrated the maturity of its critical technologies later than recommended by best practices. Only 4 of the program's 19 critical technologies were mature when the construction preparation contract was awarded in 2004. Of the program's 13 current critical technologies, 8 have not been demonstrated in a realistic environment. Three of these technologies—EMALS, advanced arresting gear, and dual band radar-present the greatest risk to the ship's cost and schedule. While CVN 21 program officials stated that the EMALS program is on schedule to deliver material to the shipyard when it is needed for construction, concurrent EMALS testing and ship construction continue to present cost and schedule risks to the program. The Navy completed a second phase of testing for the EMALS generator—an area of prior concern—and the first phase of testing for the EMALS launch motor in 2009. As a result of the tests, the program identified design changes that are necessary to improve the performance of EMALS, but add cost and schedule risk to the program. The Navy plans to test EMALS with actual aircraft in summer 2010. The advanced arresting gear includes seven major subsystems. Programs officials expect that six of the subsystems will be mature after analyzing data from a recent reliability test. The remaining subsystem—control system software—will remain immature until integrated land-based testing with actual aircraft occurs in fiscal year 2012. This testing will overlap with the first arresting gear deliveries to the shipyard. Testing of carrier specific dual band radar functionality is scheduled to conclude in fiscal year 2012. Dual band radar equipment will be delivered incrementally from fiscal years 2012 through 2014.

Design Maturity

The CVN 78 began construction in September 2008 without a complete product model. The program began production with approximately 76 percent of the 3D product model complete. In November 2009, the contractor completed the detail phase in the 3D product model. However, program officials reported that while the 3D product model is complete, some product model work will continue up to and after delivery of CVN 78. This additional work includes making design adjustments for planned just-in-time technology insertions or for unplanned delays in contractor or government furnished information.

Production Maturity

The Navy awarded the contract for CVN 78 construction in September 2008. Construction of approximately 50 percent of the ship's units are complete. According to program officials, these units are low on the ship and only account for 9 percent of the ship's production hours. The Navy awarded a not-to-exceed fixed-price production contract to General Atomics for EMALS and the advanced arresting gear in 2009. At the time of award, the contract price had not been finalized. The Navy expects to finalize the price of this contract in March 2010.

Other Program Issues

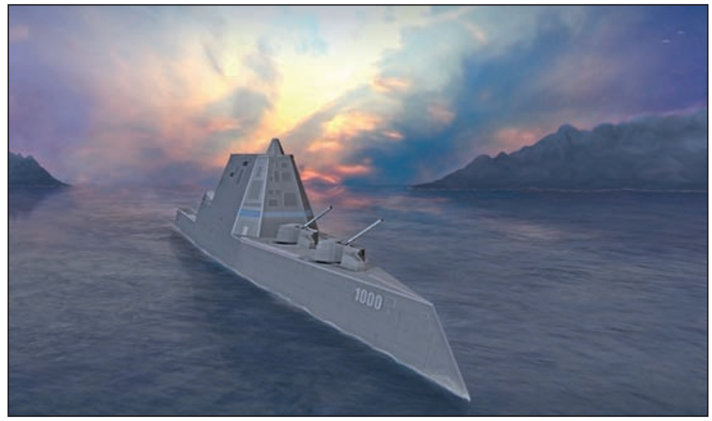
The Navy plans to use the dual band radar on both CVN 21 carriers and DDG 1000 destroyers. Given the recent decision to truncate the DDG 1000 program, CVN 21 program officials stated that the dual band radar production line may be idle for up to 4 years before production begins for CVN 79. The cost of the CVN 79 dual band radar could increase due to the costs associated with restarting the production line. In addition, the fiscal year 2010 President's Budget recommends moving the carrier to a 5-year build cycle. If adopted, the fabrication start date for CVN 80 will be delayed by 2 years, which will increase the amount of shipyard overhead costs paid under the CVN 79 contract.

Program Office Comments

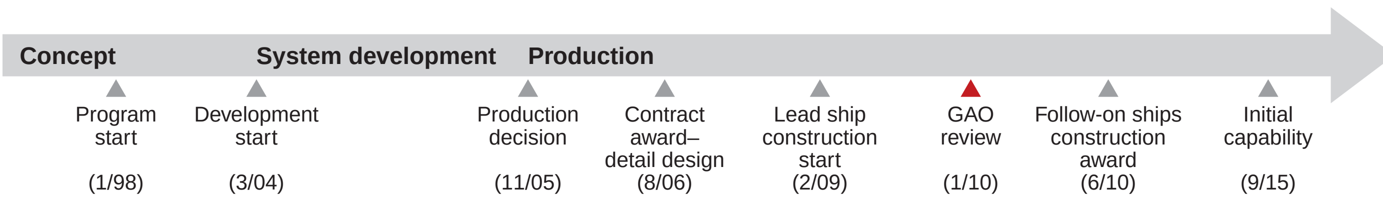
The program office generally concurs with the assessment that concurrent technology development, particularly regarding EMALS, the advanced arresting gear, and the dual-band radar system, presents the highest programmatic risk. Officials stated that all critical technologies are being aggressively managed through established processes to mitigate cost, schedule, and development risk and remain on track to meet required shipbuilder in-yard need dates.

DDG 1000 Destroyer

The Navy's DDG 1000 destroyer is a multimission surface ship designed to provide advanced land-attack capability in support of forces ashore and contributes to U.S. military dominance in littoral operations. Lead ship construction started in February 2009, and the Navy anticipates awarding construction contracts for two follow-on ships by June 2010. Bath Iron Works will build all three ships in this class with key segments built by Northrop Grumman Shipbuilding Gulf Coast.



Source: PEO Ships (PMS 500).



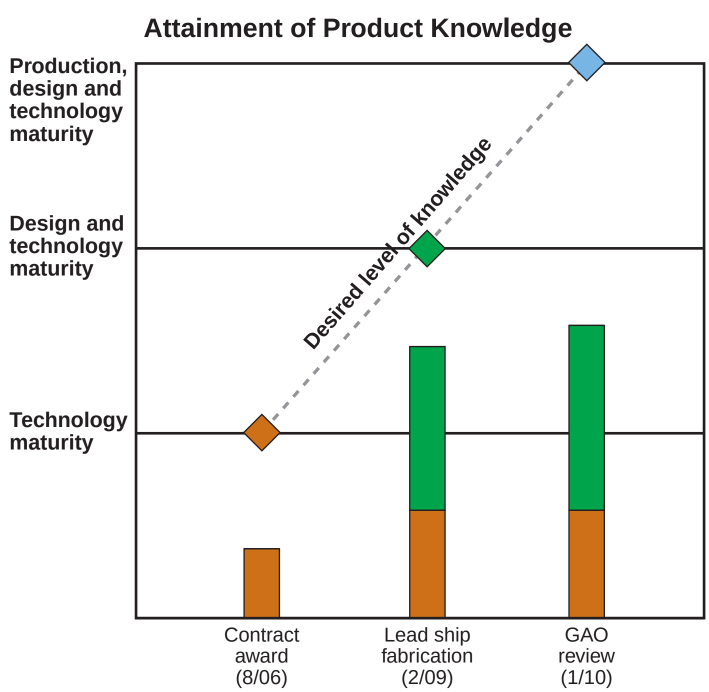
Program Essentials

Prime contractor: BAE Systems, Bath Iron Works, Northrop Grumman Shipbuilding, Raytheon
Program office: Washington, DC
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 01/1998	Latest 08/2009	Percent change
Research and development cost	$2,218.3	TBD	NA
Procurement cost	$31,726.8	TBD	NA
Total program cost	$33,945.1	TBD	NA
Program unit cost	$1,060.785	TBD	NA
Total quantities	32	TBD	NA
Acquisition cycle time (months)	128	TBD	NA

The lead DDG 1000 began construction in February 2009 with 3 of its 12 critical technologies mature and 88 percent of its design complete. The program expects to demonstrate the maturity of the deckhouse prior to its installation, but the remaining 8 technologies will not be demonstrated in a realistic environment until after installation on the ship due to testing limitations. Software development continues to be a challenge. The total ship computing environment will not be completed until after the lead ship's systems are activated. The Navy's truncation of this program from 7 to 3 ships will likely increase the cost per ship. Navy officials reported that this could lead to a critical Nunn-McCurdy unit cost breach. The Navy requested $310 million in fiscal year 2010 and will require additional funds through 2014 to cover costs that would have been distributed over the 7-ship program.



DDG 1000 Program

Technology Maturity

Three of DDG 1000's 12 critical technologies are mature, and an additional 8 have been demonstrated in a relevant environment. Practical limitations prevent the Navy from fully demonstrating all technologies in a realistic environment prior to installation. The Navy planned to fully demonstrate the integrated deckhouse prior to ship construction start in February 2009, but land-based testing was delayed. Testing is now scheduled to complete by March 2010—over a year after deckhouse construction began. The integrated power system will not be tested with the control system until 2011—nearly 3 years later than planned. As a result, the power system will not be demonstrated until after its installation on the first two ships. The volume search radar has progressed in maturity and began testing with the multifunction radar in January 2009. However, program officials report that the tests were conducted without the volume search radar's radome and at a lower voltage than required. The lead ship's volume search radar will be installed in April 2013—after the Navy has taken custody of the ship. The total ship computing environment (phased over six releases and one spiral) remains at a lower level of maturity and will not be completed until after the lead ship's systems are activated. Program officials report that problems identified in release 4 have been resolved in release 5, which is currently undergoing integration testing. However, the Defense Contract Management Agency expects that problems discovered in releases 4 and 5 will cause release 6 to have higher defect rates than planned, and additional cost and schedule delays.

Design Maturity

The design of the DDG 1000 appears stable, although the continuing maturation of critical technologies could result in design changes. The design was 88 percent complete at the start of lead ship construction, and 100 percent complete shortly thereafter.

Production Maturity

Lead ship construction began in February 2009 and 68 percent of the units that make up the ship are now in fabrication. The Navy reported that it contractually requires the shipbuilders to specify detailed structural attributes to be monitored during unit fabrication and integration in order to reduce the risk of rework. According to program officials, this contractual requirement is a first for large Navy shipbuilding programs. The program initially experienced higher than expected rejection rates on the peripheral vertical launch system, which program officials reported were resolved. The Navy anticipates awarding construction contracts for the second and third ships by June 2010.

Other Program Issues

The Navy reduced the number of ships in the DDG 1000 program from 7 to 3 ships in fiscal year 2008. Program officials stated that truncating the program will likely cause an increase in the cost per ship. Navy officials reported that this could result in a Nunn-McCurdy unit cost breach of the critical cost growth threshold. In addition, some contractor costs that were previously distributed over the planned 7-ship program will now be allocated to the 3-ship program. In fiscal year 2010, the Navy requested $310 million to fund these costs. The Navy anticipates requesting additional funds for this purpose during fiscal years 2011-2014.

The Navy is conducting a Future Surface Combatant study, which program officials say includes a review of hull options for this new ship program. One option being considered is the DDG 1000 hull form. The Navy expects to incorporate the final decision from this study in the fiscal year 2011 budget.

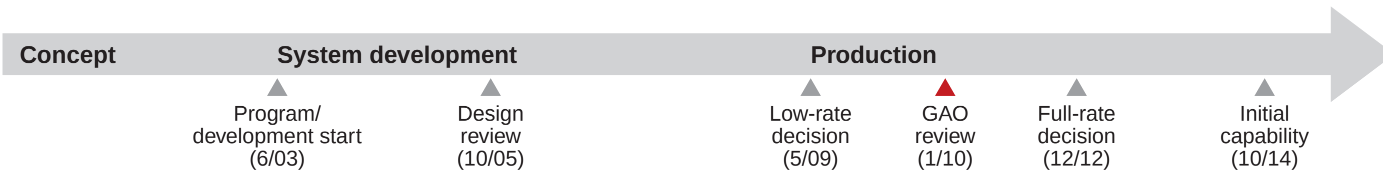
Program Office Comments

The Navy stated that three critical technologies are mature and that all technologies have been demonstrated in at least a relevant environment, except for the total ship computing environment which will increase in maturity on the completion of release 5. The Navy noted that release 5 includes most combat systems-related functionality and release 6 focuses on engineering control, which is mostly independent of combat systems. The Navy noted that the software schedule has a margin available before software is needed for land-based and ship testing. The Navy stated that the power system will be tested on land in 2011 using components of the third ship before lead ship testing begins. The Navy noted that the volume search radar prototype was built at a lower voltage to limit risk, and that prototype integration tests are not dependent on the voltage or radome. The Navy stated that full-voltage modules have been produced and tested, and that a lead-ship radar will be tested in 2012 with a radome.

E-2D Advanced Hawkeye (E-2D AHE)

The Navy's E-2D AHE is an all-weather, twin-engine, carrier-based aircraft designed to extend early warning surveillance capabilities. It is the next in a series of upgrades the Navy has made to the E-2C Hawkeye platform since its first flight in 1971. The key objectives of the E-2D AHE are to improve battlespace target detection and situational awareness, especially in the littorals; support theater air and missile defense operations; and provide improved operational availability for the radar system.

Source: Program Executive Officer, Tactical Aircraft Programs (PEO(T)).



Program Essentials

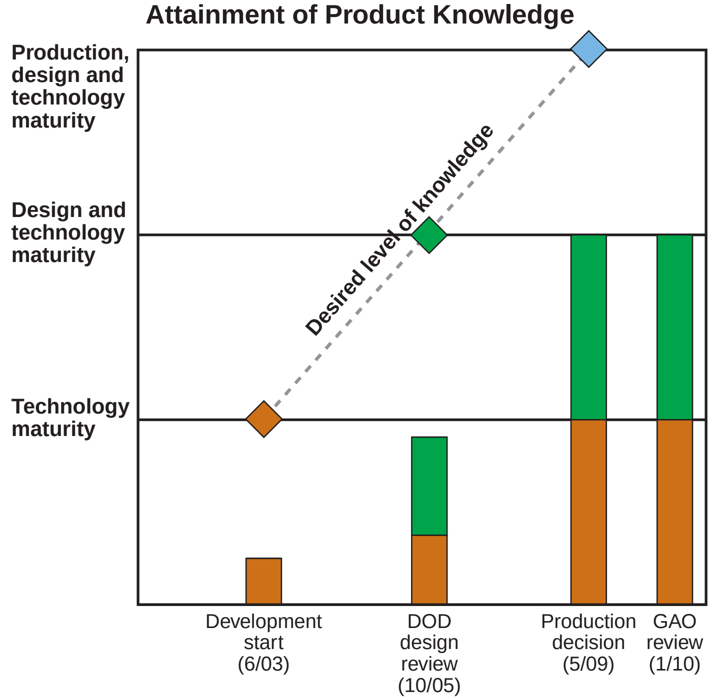
Prime contractor: Northrop Grumman Corp.
Program office: Patuxent River, MD
Funding needed to complete:
R&D: $606.9 million
Procurement: $12,874.4 million
Total funding: $13,516.9 million
Procurement quantity: 68

Program Performance (fiscal year 2010 dollars in millions)

	As of 06/2003	Latest 06/2009	Percent change
Research and development cost	$3,746.9	$4,181.4	11.6
Procurement cost	$10,643.9	$13,414.7	26.0
Total program cost	$14,390.8	$17,643.3	22.6
Program unit cost	$191.878	$235.244	22.6
Total quantities	75	75	0.0
Acquisition cycle time (months)	95	136	43.2

The E-2D AHE was approved for entry into low-rate initial production in June 2009. All five of the E-2D AHE's critical technologies are considered mature. The E-2D AHE design is stable and the rate of design drawing growth has slowed. We did not assess production maturity, but program officials reported that three pilot production aircraft were on schedule to be completed by the end of fiscal year 2010. The program has made progress in completing flight tests, but 40 percent of the test points remain to be completed before initial operational test and evaluation can begin in October 2011. Prior to the approval to enter low-rate initial production, the program experienced a critical Nunn-McCurdy breach due to unit cost growth. The initial operating capability date changed from April 2011 to October 2014 when the program expects to have a squadron ready for operational deployment.

Attainment of Product Knowledge



E-2D AHE Program

Technology Maturity

According to the Navy, all five of the E-2D AHE's critical technologies are mature. The Navy completed a technology readiness assessment in 2009 to support the low-rate initial production decision, and DOD concurred with that assessment. The assessment included one new critical technology—the high power UHF circulator. Although the assessment indicated the silicon carbide UHF transmitter was mature, DOD expressed concern about the transmitter's durability and its potential effect on life-cycle costs and operational availability.

Design Maturity

The E-2D AHE design is stable and 100 percent of total estimated design drawings are releasable. The rate of design drawing growth has continued to slow, increasing only 4 percent since last year. The program office reported that the growth in design drawings was attributable to integrating new capabilities, such as the Cooperative Engagement Capability.

Production Maturity

We did not assess production maturity. The program did not identify any critical manufacturing processes associated with the E-2D AHE, nor does the program require the contractor's major assembly site to use statistical process controls to ensure its critical processes are producing high-quality and reliable products. The E-2D AHE was approved for entry into low-rate initial production in June 2009. Program officials reported that three pilot production aircraft were on schedule to be delivered by the end of fiscal year 2010.

Other Program Issues

Prior to the approval to enter low-rate initial production, the program experienced a critical Nunn-McCurdy breach over the original acquisition program baseline due to unit cost growth. A root cause analysis indicated that the primary causes of this growth were inaccurate cost estimates for producing the radar and lower annual procurement quantities than planned. Secondary causes included increases in contractor overhead costs and added requirements. The Navy was directed to accelerate the production schedule, seek multiyear procurement authority, and investigate other initiatives to offset cost growth and improve affordability. A new acquisition program baseline was established in July 2009, and the program has been directed to report to DOD before reprogramming or budgeting additional funding if program costs exceed 10 percent of the new baseline. The initial operating capability for the E-2D AHE changed from April 2011 to October 2014 due to budget cuts in fiscal year 2009 and a change in the program's definition of initial operating capability. The program changed initial capability from having a fleet squadron ready for testing to having a fleet squadron ready for operational deployment.

The program has made progress in completing flight testing, particularly with respect to the radar system. Approximately 60 percent of the planned test points have been completed, with the remaining 40 percent scheduled for completion before initial operational test and evaluation in October 2011. Program officials plan to utilize both development aircraft and the first pilot production aircraft for mission systems testing to ensure testing is completed on time. In addition, program officials said increased aircraft availability and radar system reliability have enabled the program to conduct more test flights per month.

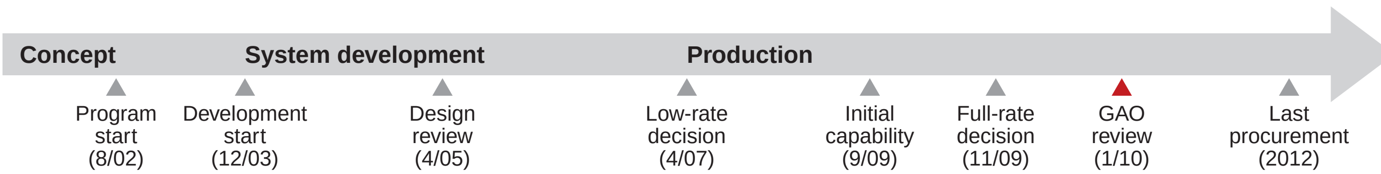
Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated as appropriate.

EA-18G Growler

The Navy's EA-18G Growler will replace the carrier-based EA-6B and provide electronic warfare capability. The EA-18G is designed to support friendly air, ground, and sea operations by suppressing enemy radar and communications. The aircraft is a combination of the EA-6B's new, more capable Improved Capability (ICAP) III electronic suite, the F/A-18F airframe, and other EA-18G unique capabilities. The program completed operational testing in March 2009 and its first deployment is anticipated in 2010.

Source: U.S. Navy.



Program Essentials

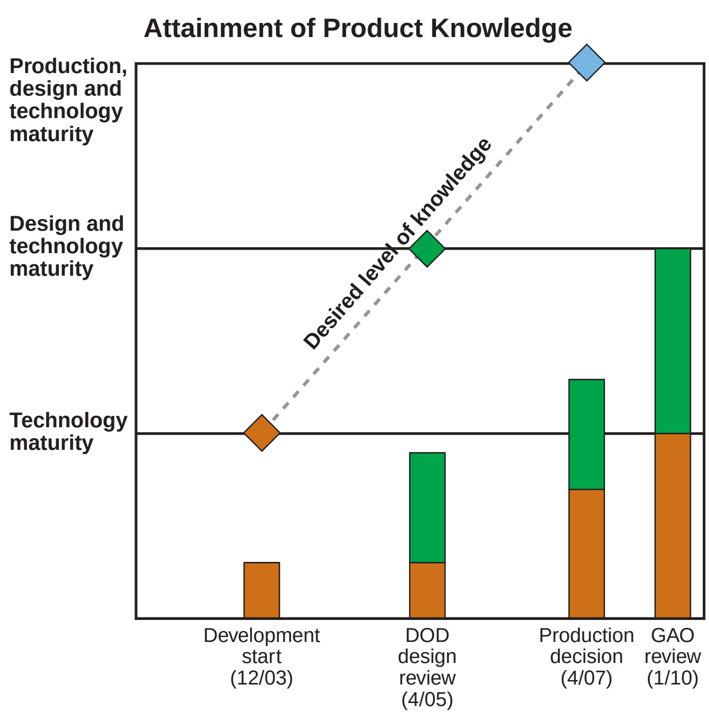
Prime contractor: Boeing
Program office: Patuxent River, MD
Funding needed to complete:
R&D: $121.3 million
Procurement: $2,465.7 million
Total funding: $2,587.1 million
Procurement quantity: 32

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2003	Latest 12/2008	Percent change
Research and development cost	$1,864.8	$1,929.7	3.5
Procurement cost	$6,890.4	$6,678.6	-3.1
Total program cost	$8,755.3	$8,632.8	-1.4
Program unit cost	$97.281	$101.562	4.4
Total quantities	90	85	-5.6
Acquisition cycle time (months)	70	69	-1.4

The 2008 data do not include three aircraft purchased with fiscal year 2008 wartime supplemental funding.

The EA-18G was approved for full-rate production in November 2009, prior to deficiencies identified during operational testing being fully resolved. In operational tests, the Navy rated the EA-18G operationally effective and operationally suitable; however, the Director of Operational Test and Evaluation (DOT&E) found the aircraft to be operationally effective for most missions and not operationally suitable. This difference can be primarily attributed to how the organizations accounted for the poor reliability of the ALQ-99 jamming pod. In addition, the simultaneous operation of the active electronically scanned array radar and the airborne electronic attack suite degraded the radar's performance in certain situations. Despite these shortcomings, most aircraft were either procured or funds were requested prior to a full-rate production decision.



EA-18G Program

Technology and Design Maturity

All of the EA 18-G's technologies are mature and its design is stable.

Production Maturity

We could not assess production maturity because the program does not collect statistical process control data. We have previously expressed concerns about the EA-18G's aggressive production schedule. The current EA-18G program of record includes 88 aircraft. A full-rate production decision was made in November 2009. The Navy has scheduled follow-on operational test and evaluation for spring of 2010 which will allow full evaluation of new software, as well as other actions to improve current suitability problems. Prior to the full-rate production decision, 56 aircraft were procured. Funding for an additional 22 aircraft was requested in the fiscal year 2010 budget even though the operational test reports by the DOT&E had not yet been published.

Other Program Issues

The Navy test organization and DOT&E have reached different conclusions about the operational effectiveness and suitability of the EA-18G.

The Navy assessed the EA-18G as operationally effective and identified one negative warfighting effect—poor ALQ-99 reliability. It also rated the EA-18G as operationally suitable but identified a total of seven major deficiencies. The Navy testers recommended fleet introduction of the EA-18G and noted that follow-on tests would be used to demonstrate that deficiencies had been corrected.

DOT&E's independent assessment found the EA-18G to be operationally effective for most, but not all missions, due to the excessive time required to make reactive jamming assignments. In addition, during tests, electromagnetic interference in some frequency bands from the EA-18G's airborne electronic attack (AEA) suite degraded active electronically scanned array (AESA) radar performance. The Navy operational testers did not consider this a deficiency because the capability production document only required independent operations of the AESA and AEA systems. DOT&E noted this deficiency in their operational effectiveness assessment. Also, DOT&E found that the EA-18G was not operationally suitable, due to significant problems with the built-in-test (BIT). A high rate of false BIT indications frequently led to a lack of aircrew confidence in the AEA system health, which can impact the decision on whether or not to take the aircraft on a given mission. At times, the aircrews flew missions with real faults because the high rate of false indications led them to disregard BIT. The EA-18G also exhibited low reliability, due primarily to the frequent failure of the legacy ALQ-99 jamming pods and their newly designed pod interface units. Tests also found that EA-18G aircraft speed was reduced when carrying the ALQ-99 pods and external weapons, limiting its ability to keep up with the strike aircraft it was escorting. The legacy ALQ-99 pods were not considered in the Navy's assessment of the EA-18G. DOT&E further found that pilots in the two-person EA-18G have an increased workload versus the EA-6B four-person crew. In some missions the workload was acceptable, but the workload for performing radar and communications jamming for missions with modified escort profiles was close to exceeding aircrew's abilities to maintain required functionality or effectiveness.

The Navy test organization and DOT&E recommended further tests to address deficiencies found in operational tests. In late September 2009, the program started to determine if software upgrades were effective in correcting the EA-18G's major deficiencies. The DOT&E report contained recommendations to improve the EA-18G and make the aircraft fully effective and suitable and increase survivability. They include upgrading the pilot tactical situation display to minimize aircrew workload management comparable to the EA-6B, upgrading hardware and software diagnostics tools, assessing the benefits of a threat warning system, and assessing the safety and performance benefits of adding higher performance engines to the EA-18G.

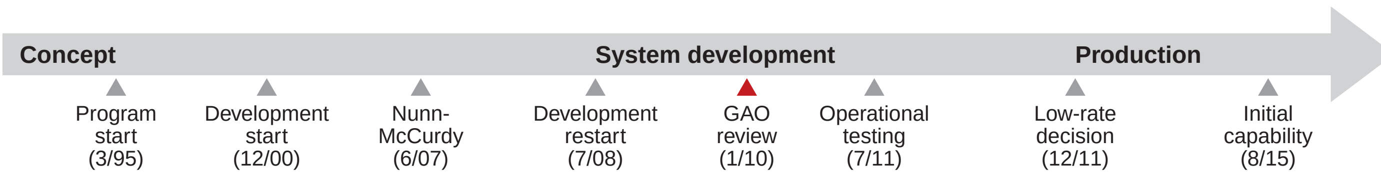
Program Office Comments

The program office stated the fleet continues to transition to the EA-18G Growler aircraft. The verification of correction test period has ended and the program office is awaiting the report of test results. The verification of corrections will be available prior to the first deployment of the EA-18G.

Expeditionary Fighting Vehicle (EFV)

The Marine Corps' EFV is designed to transport troops from ships offshore to inland destinations at higher speeds and from longer distances than the Assault Amphibious Vehicle 7A—the system it is designed to replace. The EFV will have two variants—a troop carrier for 17 combat-equipped Marines and 3 crew members, and a command vehicle to manage combat operations. DOD restructured the program in June 2007 and awarded a follow-on development contract in July 2008 that focuses on redesigning key subsystems to improve reliability.

Source: EFV Program Office.



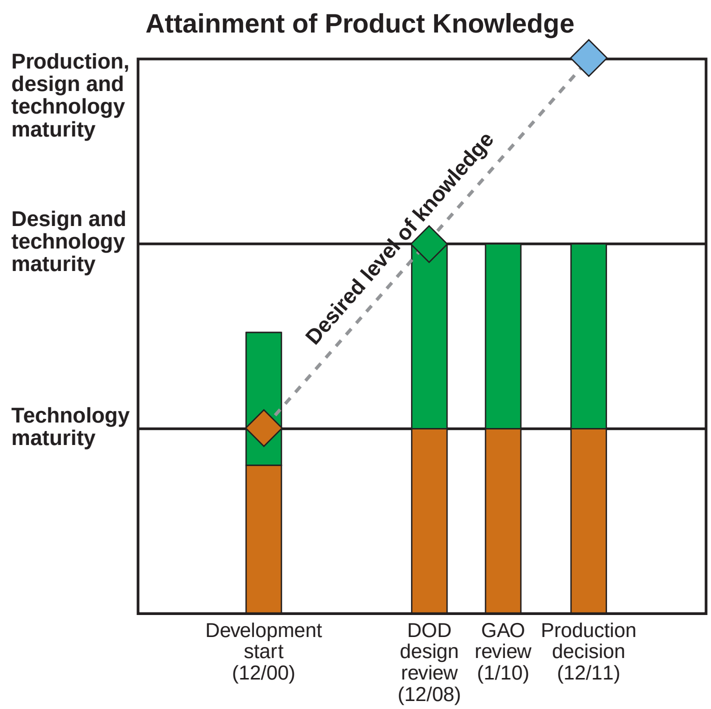
Program Essentials

Prime contractor: General Dynamics
Program office: Woodbridge, VA
Funding needed to complete:
- R&D: $866.7 million
- Procurement: $10,226.4 million
- Total funding: $11,163.6 million
- Procurement quantity: 573

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2000	Latest 08/2009	Percent change
Research and development cost	$1,609.3	$3,743.7	132.6
Procurement cost	$7,228.2	$10,445.3	44.5
Total program cost	$8,930.3	$14,286.7	60.0
Program unit cost	$8.713	$24.092	176.5
Total quantities	1025	593	-42.1
Acquisition cycle time (months)	138	245	77.5

The EFV's critical technologies are mature, but its design will continue to evolve into low-rate production as part of the design for reliability effort. DOD restructured the program in 2007 and extended system development so that the program could implement a revised approach to meet its reliability requirements. The program will conduct an operational assessment in 2011, before its low-rate initial production decision, to see if the program is on track to meet its minimum reliability requirements. Delivery of new prototypes built using mostly production-representative tooling will begin in August 2010, but the program does not intend to collect data on key manufacturing processes until low-rate production begins. In response to changing warfighter needs, the program is also planning to develop armor kits to improve protection from Improvised Explosive Devices (IED) blasts.



EFV Program

Technology Maturity

All four of the EFV system's critical technologies are considered mature and have been demonstrated in a full-up system prototype under the initial development contract.

Design Maturity

The EFV's design will continue to evolve into low-rate initial production. The Marine Corps has reported that 96 percent of the system's design models have been released; however, the program anticipates design changes will continue until 2014 as it executes its reliability growth and testing strategy. The program is addressing 180 design actions raised during its critical design review in December 2008 and plans to incorporate many of them into seven new prototypes currently under construction. The first of the new prototypes is scheduled to be delivered in August 2010. An operational assessment is scheduled for April 2011. At that time, the program expects to demonstrate on average at least 16 hours of operation between operational mission failures, which will keep the EFV on the reliability path needed to reach its minimum requirement of 43.5 hours. Additional testing and design revisions are scheduled to continue through the fourth lot of low-rate production, and the program will commit to all four low-rate production lots before conducting initial operational test and evaluation to validate the performance and reliability of the EFV.

Production Maturity

The EFV program plans to demonstrate its production processes during prototype fabrication and assess their maturity in low-rate initial production and full-rate production. According to the program office, the prototypes will be built using mostly production representative tooling and processes. However, the program will introduce new friction-welding processes during low-rate production that are expected to increase the strength of the hull and reduce weight. While the prototype vehicles will be built using production representative tooling and processes, the program does not intend to collect data on key manufacturing processes and use statistical process controls until low-rate production begins. However, the contractor does currently require that suppliers have their manufacturing processes in control for all parts associated with key system characteristics.

Other Program Issues

The EFV program has examined multiple options to increase IED protection, including adding a v-shaped hull to the vehicle, and selected armor kits that provide two levels of protection. According to the program, one kit would provide comparable protection to the MRAP, while the other kit would provide a higher level of protection comparable to the M1A1 Abrams tank. The Marine Corps recently formalized the IED requirement for the EFV, but did not make it a key performance parameter for the program. In an effort to reduce vehicle cost and weight, the program office has considered different options, such as removing a system designed to protect EFV occupants from exposure to nuclear, biological, and chemical (NBC) weapons. If the NBC system were removed, warfighters would still be protected using mission-oriented protective suits, which they currently use on the AAV-7 legacy platform. No decision has been made on this proposal, but it is being held as an option for later in the program.

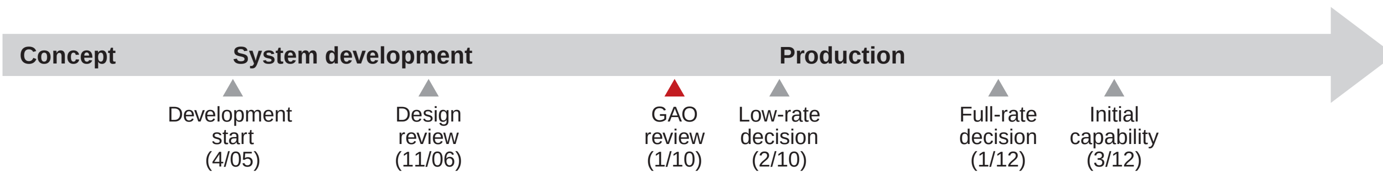
Program Office Comments

In commenting on a draft of this assessment, the program office stated that the design for reliability effort increased the reliability potential of the EFV design by utilizing overarching systems engineering processes to mature the design. This effort culminated in a design approved at Critical Design Review (CDR) that predicts a reliability of 56 hours Mean Time Between Operational Mission Failure (MTBOMF) based on models and prediction processes. Production of the SDD-2 prototypes is on track at the Joint Services Manufacturing Center (JSMC), Lima, Ohio, with deliveries planned for August 2010. Testing is on track to support Reliability Growth and the Operational Assessment prior to Milestone C.

Extended Range/Multiple Purpose Unmanned Aircraft System (ER/MP)

The Army expects its Extended Range/Multiple Purpose Unmanned Aircraft System (ER/MP) to fill a capability gap for an unmanned aircraft system at the division level. Each system will include 12 aircraft, ground control stations, ground and air data terminals, automatic takeoff and landing systems, and ground support equipment. The Army plans for ER/MP to operate alone or with other platforms such as the Longbow Apache helicopter and perform missions including reconnaissance, surveillance, and target acquisition and attack.

Source: General Atomics Aeronautical Systems, Inc.



Program Essentials

Prime contractor: General Atomics
Program office: Huntsville, AL
Funding needed to complete:
R&D: $293.5 million
Procurement: $2,197.9 million
Total funding: $2,675.0 million
Procurement quantity: 9

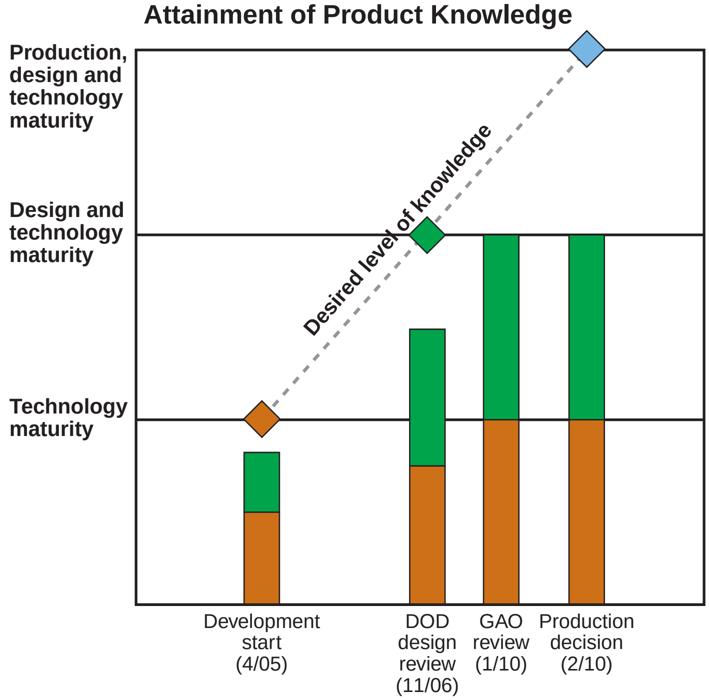
Program Performance (fiscal year 2010 dollars in millions)

	As of 04/2005	Latest 10/2009	Percent change
Research and development cost	$336.4	$824.6	145.1
Procurement cost	$653.9	$2,655.6	306.1
Total program cost	$990.3	$3,480.2	251.4
Program unit cost	$198.058	$316.385	59.7
Total quantities	5	11	120.0
Acquisition cycle time (months)	50	83	66.0

Cost and quantities shown are from program inception through 2018.

According to the Army, the ER/MP will enter production in February 2010 with its four critical technologies mature, design stable enough for low-rate production, and manufacturing processes demonstrated in a production representative environment. In 2009, the Army assessed the program's production readiness and concluded that design changes did not pose significant risk during low-rate production, and that, for critical/major suppliers, manufacturing readiness objectives had been met and manufacturing maturity was satisfactory. However, the first development test of a fully-integrated production representative unit will not occur until September 2011—a year and 7 months after the production decision. The program entered production over a year later than planned, due in part to direction from the Secretary of Defense to prioritize fielding a near-term capability.

Attainment of Product Knowledge



ER MP Program

Technology Maturity

The ER/MP program began development in 2005 with two critical technologies the Army considered mature—the heavy-fuel engine and automatic take-off and landing system—but these technologies had not been integrated onto an unmanned aircraft using exactly the same configuration as planned for the ER/MP. The program's other two critical technologies—airborne ethernet and tactical common data link—were not mature at development start and only had been demonstrated in a laboratory environment. All four critical technologies are now mature and have been demonstrated on the final version of the unmanned air system.

Design Maturity

The ER/MP design appears stable. In June 2009, the Army established a configuration change board in conjunction with the prime contractor to track engineering changes to the design. It plans to use the change rate as a measure of design stability and maturity. According to the program office, the change rate has been less than 1 percent per month.

Production Maturity

The ER/MP is expected to enter low-rate initial production in early 2010 with all its manufacturing processes demonstrated in a production representative environment. In 2009, the Army's Aviation and Missile Research, Development, and Engineering Center independently assessed the program's production readiness, including whether the system's design was stable, production planning was complete, and proper facilities were in place. The resulting November 2009 report concluded that the design of the system is mature and stable enough such that design change does not present a significant risk to the program during low-rate initial production. It also indicated that, for critical / major suppliers, manufacturing readiness objectives had been met, manufacturing process maturity was satisfactory, and manufacturing infrastructure met or exceeded requirement for low-rate initial production. However, the first development test of a fully-integrated production representative unit will not occur until initial operational test and evaluation in September 2011—a year and 7 months after the production decision.

Other Program Issues

The Army anticipates DOD will approve a new acquisition program baseline for the program in February 2010. According to the Army, the new baseline will reflect the program approved at its production decison review as well as changes resulting from a Secretary of Defense memorandum to field the capability as soon as possible. The Secretary's direction affected the program in several ways. According to program officials, it extended system development and demonstration by about 2 years and delayed the award of the low-rate initial production contract by over 1 year. In accordance with the Secretary's direction, the Army fielded one "Quick Reaction Capability" system in 2009 and plans to field another in 2010. These systems lack the full capabilities planned for the program of record.

In 2007, DOD issued a memorandum directing that the Army's ER/MP and Air Force's MQ-1C Predator unmanned aircraft systems be combined into a single acquisition program. Since that time, the Air Force has determined it will no longer acquire the MQ-1C Predator. The Army now anticipates a DOD acquisition memorandum closing the direction to combine the programs.

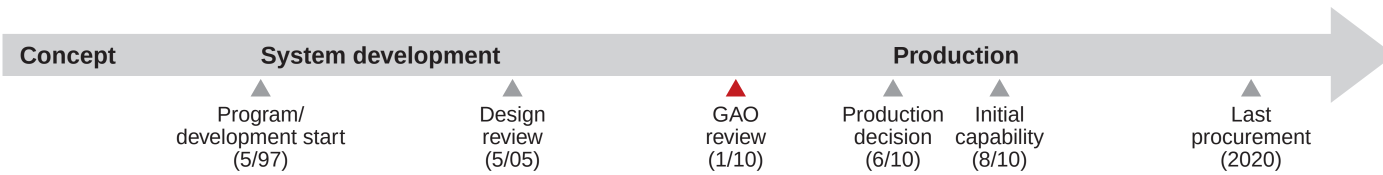
Program Office Comments

The program office provided technical comments, which were incorporated as appropriate. Program officials also stated that the program was approved in February 2010 for low-rate initial production, and they now anticipate changes in cost, quantity, and schedule. However, official, detailed information was not available in time for inclusion in this report.

Excalibur Precision Guided Extended Range Artillery Projectile

The Army's Excalibur is a family of global positioning system–based, fire-and-forget, 155 mm cannon artillery precision munitions intended to provide improved range and accuracy. The Excalibur's near-vertical angle of fall is expected to reduce collateral damage, making it more effective in urban environments. Although the original plans called for three variants, the unitary, smart, and discriminating munitions, only the unitary variant is currently being developed. We reviewed the unitary variant Increment Ia-1 and Ia-2.

Source: Office of Product Manager Excalibur.



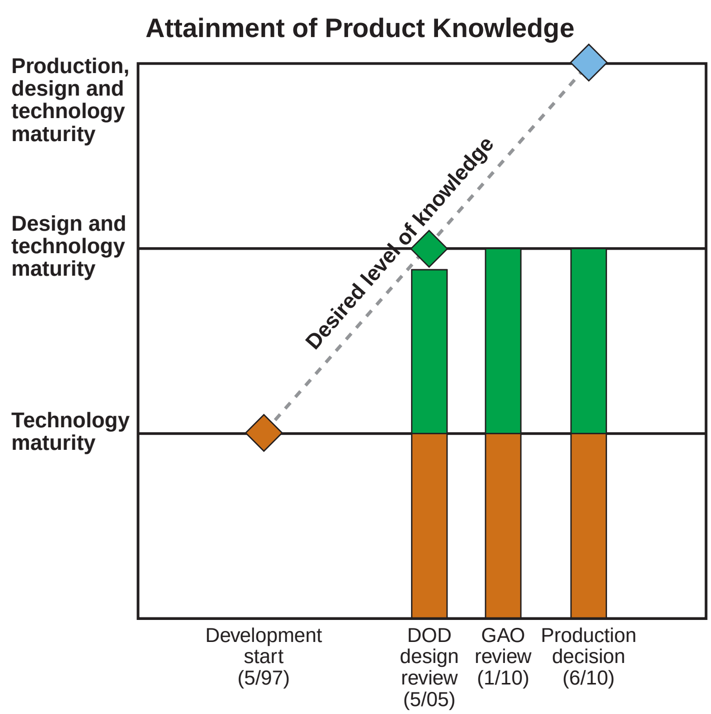
Program Essentials

Prime contractor: Raytheon
Program office: Picatinny Arsenal, NJ
Funding needed to complete:
- R&D: $74.3 million
- Procurement: $1,187.4 million
- Total funding: $1,261.7 million
- Procurement quantity: 28,035

Program Performance (fiscal year 2010 dollars in millions)

	As of 02/2003	Latest 08/2009	Percent change
Research and development cost	$746.7	$931.9	24.8
Procurement cost	$3,912.6	$1,543.5	-60.6
Total program cost	$4,659.3	$2,475.3	-46.9
Program unit cost	$.061	$.081	33.4
Total quantities	76,677	30,544	-60.2
Acquisition cycle time (months)	136	159	16.9

Excalibur Increments Ia-1 and Ia-2 are in production. According to program officials, critical technologies are mature and designs are stable for both increments. Since development began in 1997, the program has encountered a number of significant changes, including four major restructures, reduced production quantities, and increased unit costs. The Excalibur program received approval to begin production of Increment Ia-1 in May 2005 to support an urgent requirement in Iraq for more accurate artillery that would reduce collateral damage and has delivered over 400 rounds to Iraq and Afghanistan. However, the contractor experienced a series of quality issues that delayed production and Increment Ia-2 qualification, and increased program cost. Increment Ib is in engineering and manufacturing development. The program plans to select from two competitors in March 2010.



Excalibur Program

Technology Maturity

The Excalbur's three critical technologies for Increments Ia-1 and Ia-2, the airframe, guidance system and warhead, are mature. According to the program office, in both cases the technologies were demonstrated in a realistic environment at the time of their respective design reviews in May 2005 and March 2007.

The Excalibur program office has identified two critical technologies for Increment Ib, the guidance system and electronic safe-and-arm fuze. According to the program office, these technologies are nearing maturity. Two contractors are currently developing prototypes of the Increment Ib round and the program plans to down-select in March 2010.

Design Maturity

The Excalibur's design for Increments Ia-1 and Ia-2 appears to be stable. In May 2005, Excalibur held its design review and concurrently entered production to support an urgent fielding requirement for Iraq and Afghanistan. At the time of the design review, 750 of 790 design drawings were released. By August 2006, the number of drawings had increased by almost 20 percent to 943, all of which have been released. According to a program official, the increase in drawings was due to parts changes on the Increment Ia-1 as well as upgrades and changes for the Increment 1a-2.

Production Maturity

We could not assess Excalibur's production maturity because statistical process controls have not been implemented at the system level. The program is taking steps to utilize statistical process control at the subsystem and component levels. To date, over 400 complete rounds have been delivered and the program is baselining the system metrics. According to program documents, in the past year, the Excalibur contractor has experienced a quality issue that delayed production and increased program cost. The Army suspended Excalibur deliveries from November 2008 until August 2009 because of problems with the inertial measurement unit (IMU) that helps guide the projectile to the target. The IMU supplier was replaced and a new, more reliable IMU has been successfully tested and deliveries have resumed.

Other Program Issues

The Excalibur acquisition plan currently focuses on developing its unitary version in three increments—Ia-1, Ia-2, and Ib. The Increment Ia-1 projectile, which has been made available for early fielding, meets the requirements for lethality and accuracy in a nonjammed environment. The Increment Ia-2 projectile is designed to meet requirements for accuracy in a jammed environment, with extended range and increased reliability. The Increment Ib projectile is planned to further increase reliability, lower unit costs, and will be available for fielding in fiscal year 2014. Of the total planned quantity of 30,000 rounds, over 85 percent will be Increment Ib rounds. Increment Ia-1 Excalibur was fielded in Iraq with its first use in combat in 2007. Since then, more than 400 rounds have been delivered to the Army, Marine Corps, and Canadian troops both in Iraq and Afghanistan. The program office reported that over 85 percent of the rounds expended in combat operations functioned as expected. Increment Ia-2 is currently in the final stages of development. Increment Ia-2 has been approved for production, but production deliveries are pending the completion of initial operational testing, scheduled for the second quarter of fiscal year 2010. The Excalibur program awarded fixed price incentive fee contracts to Allied Techsystems and Raytheon for a planned 18-month design maturation and demonstration period for the Increment Ib round in September 2008. This will lead to a contractor down-select in March 2010.

Program Office Comments

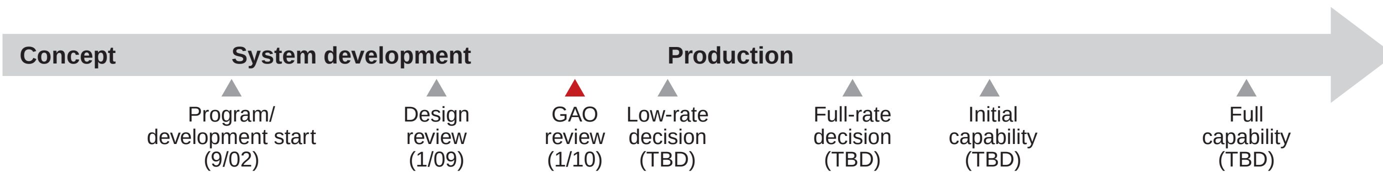
The program office noted that the Excaliber is on track to meet the Army's performance, schedule, and cost requirements. The newly incorporated IMU has been successful and resulted in an improved reliability rate for rounds produced since July 2009. The Excaliber will enter into initial operational testing in January 2010 and a full-rate production decision is expected in June 2010. The program is meeting or exceeding its key performance parameters. The current accuracy of the system exceeds its requirements, providing the Excaliber with the lowest collateral damage estimate of all precision guided munitions. The current Increment 1b development contract includes not-to-exceed production options and is on track to meet its program unit costs.

The program office also provided technical comments, which we incorporated as appropriate.

Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)

The Air Force's FAB-T will provide a family of satellite communications terminals for airborne and ground-based users. FAB-T will address current and future communications capabilities and technologies, replacing many program-unique terminals. FAB-T is being developed incrementally; the first increment will provide voice and data military satellite communications for nuclear and conventional forces as well as airborne and ground command posts, including the B-2, B-52, RC-135, E-6, and E-4 aircraft. We assessed the first increment.

Source: Boeing.



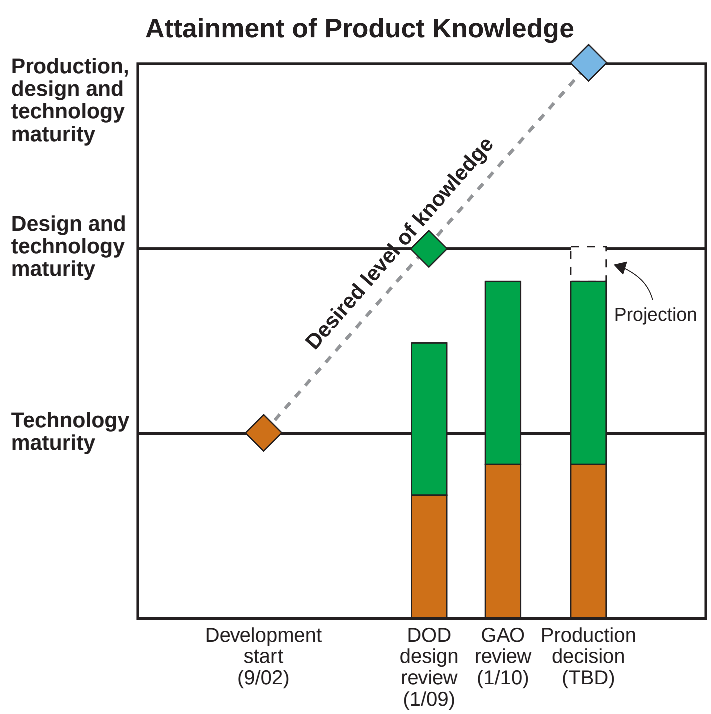
Program Essentials

Prime contractor: Boeing Company
Program office: Hanscom AFB, MA
Funding needed to complete:
R&D: $435.1 million
Procurement: $2,213.1 million
Total funding: $2,648.1 million
Procurement quantity: 216

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2006	Latest 09/2009	Percent change
Research and development cost	$1,499.5	$1,731.8	15.5
Procurement cost	$1,610.9	$2,217.5	37.7
Total program cost	$3,110.4	$3,949.4	27.0
Program unit cost	$14.400	$16.253	12.9
Total quantities	216	243	12.5
Acquisition cycle time (months)	129	129	0.0

The FAB-T program expected to enter production in February 2010 with its critical technologies mature and its design stable; however, the program now plans to extend its development phase. A new low-rate production decision date has not been approved and the program has not identified its critical manufacturing processes or started to collect statistical process control data to demonstrate their maturity. In the past year, the FAB-T program received the first engineering design model, completed developmental testing of the low-data rate system, and began testing of the high-data rate system. The program anticipates two significant engineering change proposals prior to the low-rate production decision. The FAB-T program office also continues to monitor two areas—certification by the National Security Agency and software development—that could cause cost increases and schedule delays.



FAB-T Program

Technology Maturity

The FAB-T program expected to enter production with all six critical technologies mature and demonstrated in a realistic environment. According to program officials, four critical technologies were mature as of August 2009. FAB-T's critical technologies were not assessed at development start in 2002 because it was not yet a major defense acquisition program. In December 2008, a technology readiness assessment concluded that all six critical technologies required additional testing to fully demonstrate their maturity. The assessment also deemed a seventh technology—radiation hardening—to be immature, but noncritical, and removed it as a critical technology. Since that review, the program office has assessed four of the critical technologies as mature based on the results of flight testing.

Design Maturity

The FAB-T design appears stable based on the number of design drawings releasable to manufacturing. As of August 2009, 88 percent of the total expected drawings were releasable, and the program office expects that all drawings will be releasable by its production decision. In the last year, the number of total expected drawings has increased by 22 percent due, in part, to new drawings for the extended-data rate (XDR) system variant, subassemblies, and the security module. Program officials anticipate that two additional engineering changes—one related to hardware obsolescence and another related to software changes for FAB-T's interface with AEHF—will increase the estimated cost of the FAB-T contract by approximately $50 million prior to the production decision.

The FAB-T program office also continues to monitor two areas—certification by the National Security Agency (NSA) and software development—that could cause cost increases and schedule delays. FAB-T needs to properly protect information at various classification levels and NSA will provide a certification of the cryptography in certain equipment. In June 2009, the NSA completed a review of the low-date rate low data rate (LDR) version of system software and approved limited use of the FAB-T cryptographic element in program test events. While NSA is currently scheduled to complete final certification based on a production-like terminal in fiscal year 2011, program officials said that pending engineering changes will likely delay certification by 3 to 6 months. Since last year, the total lines of software code expected in the final FAB-T system have increased by over 8 percent, and software development costs have increased by almost 12 percent. These increased costs are primarily a result of engineering change proposals, internal requirements reallocations, and higher costs associated with LDR integration and XDR coding complexity.

Production Maturity

The FAB-T low-rate production decision was scheduled for February 2010, but the program now plans to extend its development phase and a new low-rate production decision date has not yet been approved. Program officials stated that the program has not yet identified its critical manufacturing processes. According to the program office, a production readiness assessment, previously planned for January 2010, will still be conducted to support the low-rate production decision but has not yet been rescheduled.

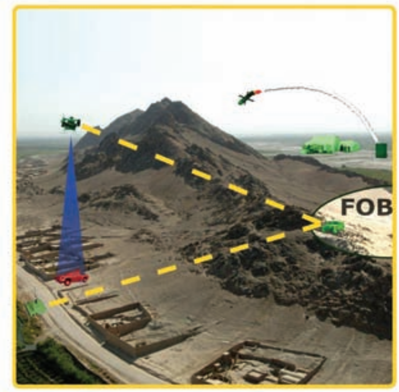
In January 2009, the contractor delivered the first FAB-T engineering design model. According to program officials, FAB-T has completed all the objectives for developmental flight testing of the hardware for the LDR system. The XDR system will undergo most of its testing concurrently with low-rate production. Operational testing for the XDR system is not scheduled to begin until after the first AEHF satellite has launched, which is currently scheduled for September 2010. The FAB-T program is planning to procure almost half of its units during low-rate production.

Program Office Comments

The Air Force concurred with our assessment; however, they noted that they are currently replanning the program, which will affect the data presented. The Air Force provided additional technical comments, which were incorporated as appropriate.

Future Combat System Spin Out Early-Infantry Brigade Combat Team

The Army's E-IBCT will augment brigade-level capabilities through an incremental, expedited fielding of some systems to current forces. The first increment, scheduled for fielding in late 2011, includes unattended munitions and sensors, unmanned ground and air vehicles, and new radios and battle command software. Increment 1 content derives from Army efforts to "spin out" selected Future Combat System capabilities to current forces. The Army anticipates at least one follow-on increment.



Source: PEO Integration approved Case 09-9146.

Concept | **System development** | **Production**

- Program/development start (7/04)
- Limited user test (9/09)
- Design review (10/09)
- Low-rate decision (12/09)
- GAO review (1/10)
- Limited user test (9/10)
- Initial capability (9/11)
- Full-rate decision (12/11)
- Last procurement (unknown)

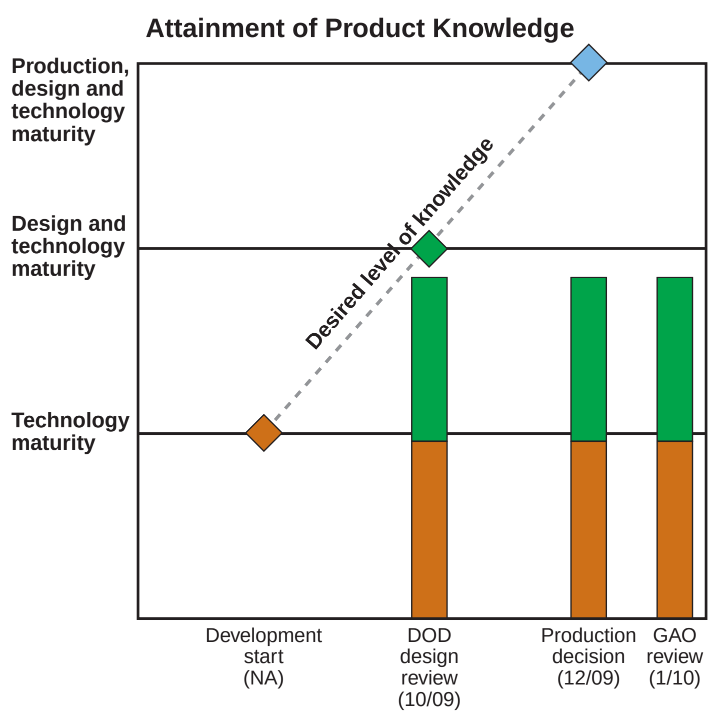
Program Essentials

Prime contractor:
Program office: Hanscom AFB, MA
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2006	Latest 12/2009	Percent change
Research and development cost	NA	NA	NA
Procurement cost	NA	NA	NA
Total program cost	NA	NA	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Despite recognized technology and design issues, DOD authorized E-IBCT Increment 1 to enter low-rate initial production in December 2009. The Army rated 9 of the E-IBCT's 10 critical technologies as mature, but testing has revealed reliability and performance issues with many Increment 1 systems. In addition, while the Army has held design reviews for the individual systems and the E-IBCT as a whole, system designs continue to change. The Army has not been able to test the full capabilities of E-IBCT systems and has been forced to use non-production-representative or surrogate systems in some tests. In March 2010, DOD plans to review the Army's progress on addressing issues with network capabilities, system and sensor reliability, and the performance and cost effectiveness of the non-line-of-sight launch system. A decision on future E-IBCT production is planned for December 2010.



FCS SO E-IBCT Program

Technology Maturity

According to the Army, 9 of the 10 E-IBCT critical technologies are fully mature. However, while the Army reported that the radio technologies were mature, its assessment was based on testing that used non-production representative systems. According to the Army, the cross-domain guard solution, which enables information sharing between classified, unclassified, and allied networks, is nearing maturity. The Army expects to demonstrate the technology's maturity in a realistic environment in a 2010 limited user test. When the E-IBCT Increment 1 was approved to enter production in December 2009, the Undersecretary of Defense for Acquisition, Technology, and Logistics raised concerns about the maturity of the systems' network capability and the performance of software-defined radios and their associated waveforms. The Director, Defense Research and Engineering will conduct a technology readiness assessment of the network capability to support a March 2010 DOD review of the E-IBCT program.

Design Maturity

E-IBCT system designs are not yet stable. In 2009, Army test officials discovered performance issues that will result in design changes. For example, the small unmanned ground vehicle could not provide infrared imagery necessary to recognize a person at required distances, and thus the system will need design improvements. Similarly, the Army is considering a change to the unmanned air system's design because the air vehicle can be heard from a considerable distance. E-IBCT system designs may also change due to reliability issues. As indicated at the E-IBCT critical design review in October 2009, four of the E-IBCT's systems did not meet reliability goals established as criteria for entry into production. For example, the tactical unattended ground sensor is required to operate 127 hours between failures. The Army currently estimates that it can operate 5 hours. Also, the unmanned aerial system is required to operate 23 hours between system aborts, but testing has only proven the system can achieve 4 hours. As a result of these design issues, some E-IBCT systems have released few, and in some cases, no engineering drawings to manufacturing. For example, the redesigned tactical unattended ground sensor requires 13 drawings, but none of them have been released. The range-extending relay, which was recently incorporated to address the insufficient range of tactical sensor radios, requires 8 drawings, but none have been released.

Production Maturity

We did not collect production maturity data for the Increment 1 systems.

Other Program Issues

Despite recognized technical issues and evolving system designs, DOD authorized low-rate production of Increment 1 systems in December 2009. The lack of systems' maturity adversely affected DOD's ability to assess the capabilities of E-IBCT Increment 1 systems prior to this decision. Specifically, an Army test report stated that this lack of maturity reduced the ability to assess and refine tactics, techniques, and procedures; test the full capabilities of some systems; and examine Increment 1 systems' contributions to mission success. The Army plans to continue to develop the systems' designs at least until the initial operational test and evaluation in 2011. This approach presents the risk that articles delivered for operational testing will not be representative of final production articles.

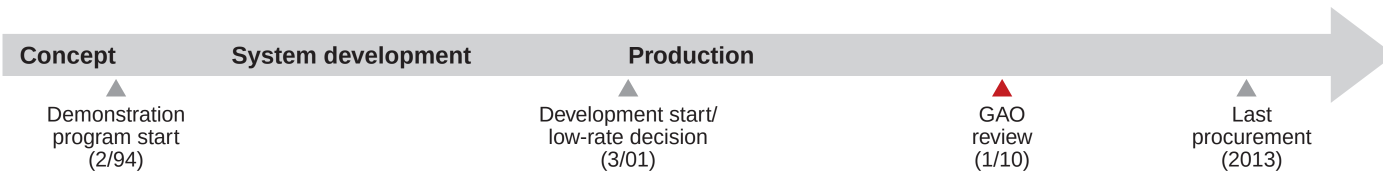
Program Office Comments

According to program officials, Increment 1 provides the capability to significantly improve soldiers' battlefield knowledge and safety. It also provides enhanced tactical data across the brigade using current networks and provides the foundation for future capabilities. It uses an acquisition approach designed to rapidly develop, test, and field systems. There were 16 months between the decision to make infantry brigades the focus of fielding and the production decision, which included acceleration of unmanned systems. Test results from 2009 enabled DOD officials to make the decision to produce enough items for a single brigade in support of initial operational testing in 2011. Limited user testing this summer will evaluate possible upgrades to these initial items. This testing will inform a future decision on whether to produce enough systems to equip two additional brigades. After initial operational testing, the Army will ask for production of six more brigade sets.

Global Hawk Unmanned Aircraft System

The Air Force's Global Hawk system is a high-altitude, long-endurance unmanned aircraft with integrated sensors and ground stations providing intelligence, surveillance, and reconnaissance capabilities. The Global Hawk will replace the U-2. After a successful technology demonstration, the system entered development and limited production in March 2001. In total, the program will procure 7 RQ-4A aircraft similar to the original demonstrators and 47 larger and more capable RQ-4Bs. RQ-4A production is complete. We assessed the RQ-4B.

Source: Northrop Grumman Corporation, 94 ABW/PA #09306.



Program Essentials

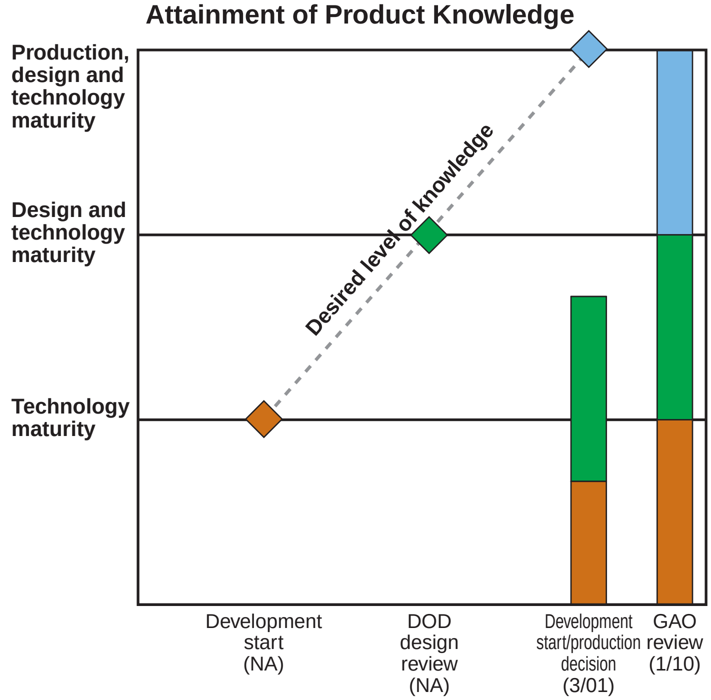
Prime contractor: Northrop Grumman Corporation
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
- R&D: $1,020.6 million
- Procurement: $2,823.7 million
- Total funding: $3,844.3 million
- Procurement quantity: 20

Program Performance (fiscal year 2010 dollars in millions)

	As of 03/2001	Latest 07/2009	Percent change
Research and development cost	$1,016.1	$3,630.3	257.3
Procurement cost	$4,212.8	$6,158.4	46.2
Total program cost	$5,259.7	$9,901.9	88.3
Program unit cost	$83.487	$183.369	119.6
Total quantities	63	54	-14.3
Acquisition cycle time (months)	55	TBD	TBD

The Global Hawk RQ-4B aircraft is currently in production. The RQ-4B's critical technologies are mature, but integration and testing are not complete. The basic airframe design is stable, and the program office reports that the airframe production processes are mature. Development and operational tests to verify the design and ensure performance meets warfighter requirements have been delayed over 3 years due to hardware and software problems. The program expects to have procured more than 70 percent of the planned quantity by the time testing is completed. Further, operational testing on the advanced radar will not be complete until 2013, the last year of planned procurement. Problems found during testing could require costly redesigns and retrofits. The RQ-4B is expected to replace the U-2, but Global Hawk delays have kept the U-2 in the inventory longer than anticipated.

Attainment of Product Knowledge



Global Hawk Program

Technology Maturity

The critical technologies for the RQ-4B are mature. These technologies include two key capabilities—the advanced signals intelligence payload and multiple platform—radar-that are required for the larger RQ-4B. However, the program must still successfully integrate and test these technologies to ensure they perform as expected. The first flight of a RQ-4B equipped with the signals intelligence payload occurred in September 2008. The completion of development and operational testing has been delayed until November 2010. Development of the advanced radar has also experienced delays. The radar has flown on an aircraft similar to the Global Hawk, however its operational testing has been delayed by more than 2 years.

Design Maturity

The RQ-4B basic airframe design is stable with all of its engineering drawings released. During the first year of production, however, frequent substantive engineering changes increased development and airframe costs and delayed delivery and testing. Differences between the RQ-4A and the RQ-4B were much more extensive and complex than anticipated.

Production Maturity

According to the program office, the manufacturing processes for the RQ-4B airframe are fully mature and in statistical control. In addition, the program reports that it is meeting its quality goals on measures such as scrap and rework rates and number of nonconforming parts. The RQ-4B aircraft is being produced in three configurations. Block 20 aircraft are equipped with an enhanced imagery intelligence payload; block 30 aircraft have both imagery and signals intelligence payloads; and block 40 aircraft will have an advanced radar surveillance capability. All six block 20 aircraft have been produced. Production continues on block 30 and block 40 aircraft. Thirty-four total aircraft have been procured through fiscal year 2009. The first block 30 aircraft was delivered to the Air Force in November 2007 and delivery of the first block 40 aircraft is expected in September 2010.

Other Program Issues

The Global Hawk program has continued to experience delays in development and operational testing. First, the Air Force issued a Joint Urgent Operational Need to install the Battlefield Airborne Communications Node—an airborne communication system—on two block 20 aircraft. According to program officials, the shift in focus and resources required for this effort has contributed to block 40 operational test delays. In addition, the completion of operational tests to verify that the basic RQ-4B design works as intended has been delayed to November 2010—now more than 3 years later than originally planned. Program officials said a number of factors contributed to the most recent schedule slip, including developmental test problems, software deficiencies, and parts failures. The program expects to have procured more than 70 percent of the total program quantities by the time operational testing is completed. Further, follow-on block 40 operational tests will not be completed until fiscal year 2013, the last planned year of procurement. Problems found during testing could require costly redesigns and retrofits and result in further delays in deliveries to the warfighter. The Air Force plans to replace the U-2 with the RQ-4B, but Global Hawk delays have kept the U-2 in the inventory longer than anticipated.

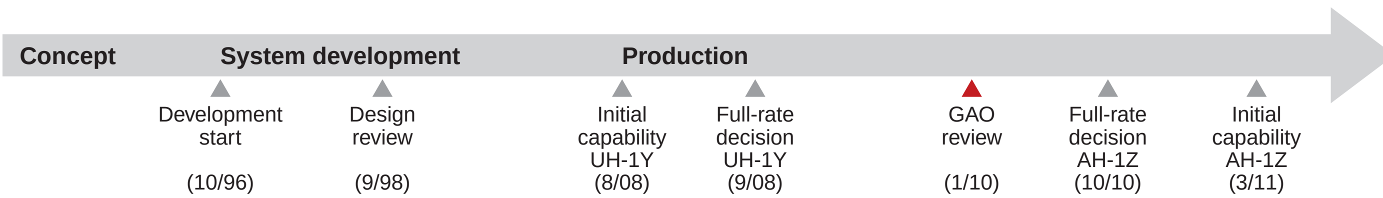
Program Office Comments

The Air Force stated that the Global Hawk program made significant strides in program execution while reducing program risk. Three deployed RQ-4A aircraft supported Overseas Contingency Operations amassing almost 8,000 combat hours in 2009 and over 37,000 total program flying hours to date. The larger and more capable RQ-4B aircraft continued development testing including flying all three blocks of RQ-4B aircraft and achieving Air Worthiness Certification. Two block 20 aircraft will be outfitted to support high-priority communications tasks. The new signals intelligence payload continued testing on the block 30 aircraft and will enter operational testing in 2010. The advanced radar payload will be integrated into and begin testing on the block 40 aircraft in 2010. Operational testing of block 20/30 aircraft are key 2010 events. Current program challenges include: software production, production acceptance, and normalization of sustainment and operations.

H-1 Upgrades (4BW/4BN)

The Navy's H-1 Upgrades Program converts the AH-1W attack helicopter and the UH-1N utility helicopter to the AH-1Z and UH-1Y configurations, respectively. The mission of the AH-1Z attack helicopter is to provide rotary wing fire support and reconnaissance capabilities in day/night and adverse weather conditions. The mission of the UH-1Y utility helicopter is to provide command, control, and assault support under the same conditions.

Source: USMC Light/Attack Helicopter (H-1) Program Office, PMA276.



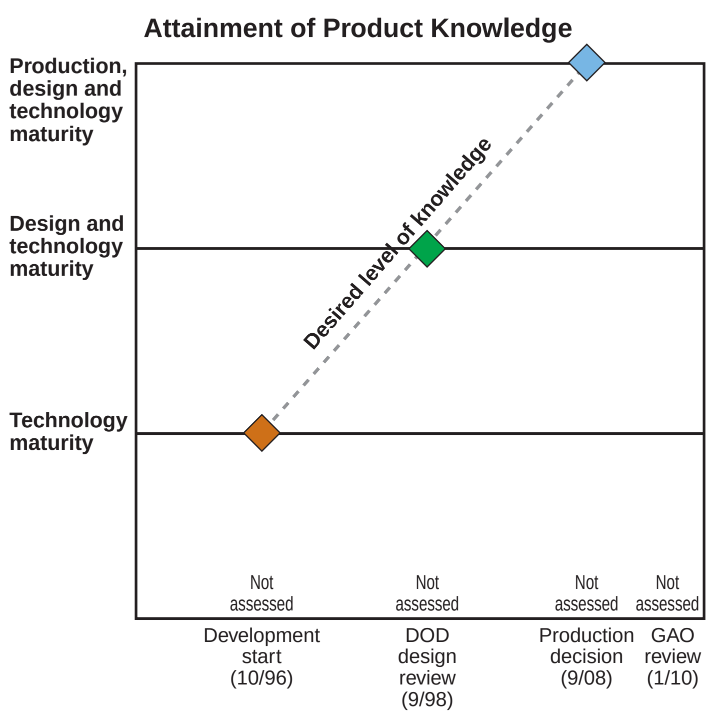
Program Essentials

Prime contractor: Bell Helicopter Textron
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $261.5 million
- Procurement: $7,112.8 million
- Total funding: $7,374.2 million
- Procurement quantity: 280

Program Performance (fiscal year 2010 dollars in millions)

	As of 10/1996	Latest 12/2008	Percent change
Research and development cost	$680.2	$1,835.2	169.8
Procurement cost	$2,856.6	$9,689.1	239.2
Total program cost	$3,536.7	$11,524.3	225.8
Program unit cost	$12.453	$32.647	162.2
Total quantities	284	353	24.3
Acquisition cycle time (months)	105	142	35.2

The AH-1Z and UH-1Y configurations are in production. According to the program office, their technologies are mature and designs are stable. We did not assess production maturity because the program does not use statistical process controls. The program office tracks postproduction quality metrics and delivery performance and reported meeting its goals on the latest aircraft delivered. Over the course of the program, production has proceeded slower than expected, due in part to supplier base issues. Program officials believe these problems could be resolved if advanced procurement funding is made available. In December 2008, the Navy reported a unit cost breach of the significant cost growth threshold. According to the revised baseline, the completion of AH-1Z operational testing will be delayed 28 months to July 2010 with a full-rate production decision to follow in October 2010.



H-1 Upgrades Program

Technology and Design Maturity

According to the program office, all of the technologies in the AH-1Z and UH-1Y configurations are mature. In addition, their designs appear stable. Program officials reported that the helmet-mounted display issues which limited UH-1Y operational testing in 2008 have been resolved. In February 2009, DOD approved a plan to redesign the main rotor cuff and yoke to improve performance and reduce life cycle cost. The program's maneuverability requirement—a key performance parameter—was previously reduced because of the static strength limitations of the main rotor. The program does not plan to retrofit aircraft with the redesigned components, but will replace them during normal maintenance.

Production Maturity

DOD approved full-rate production for the UH-1Y in September 2008 and low-rate initial production for the AH-1Z in October 2003. We did not assess production maturity because the program does not use statistical process controls. Instead, the program office tracks postproduction quality metrics and delivery performance and reported meeting its goals on the latest aircraft delivered.

Overall, production has proceeded slower than expected, due in part to supplier base issues. Beginning in fiscal year 2010, the program will request advanced procurement funding to support fiscal year 2011 production. Program officials state that this funding will help resolve prior supply issues. However, the contractor has not yet demonstrated that it can produce the aircraft at the rate—28 aircraft—called for in the program's fiscal year 2010 budget request and revised acquisition program baseline. Although the program reports that its maximum annual production rate is 32 aircraft, to date it has not delivered more than 12 aircraft in a single year. In 2009, the program expects to accept delivery of six aircraft.

Other Program Issues

In August 2009, a DOD report on the H-1 Upgrades Program cited improvements in operational performance, production deliveries, and cost containment. An initial deployment of three UH-1Ys was completed in July 2009, and a second deployment of nine UH-1Ys to Afghanistan began in October 2009. The program has also addressed performance issues with AH-1Z weapons components. Gun control corrections have been tested and verified and the target sight system has undergone risk reduction testing without experiencing hardware reliability failures.

In December 2008, the Navy reported a unit cost increase of 19 percent over the program's then current baseline, breaching the significant cost growth threshold. Program officials stated this breach was due to growth in the cost of material, labor, government furnished equipment, and nonrecurring engineering. This breach followed four previous major restructuring efforts. The program's new acquisition program baseline delays completion of operational testing for the AH-1Z by 28 months from March 2008 to July 2010 and establishes a new full-rate production decision review for the AH-1Z, which is planned for October 2010. The revised baseline also accounts for an almost 25 percent increase in planned procurement quantities from 280 to 349 aircraft (123 UH-1Ys and 226 AH-1Zs) to support the Marine Corps' growth plans.

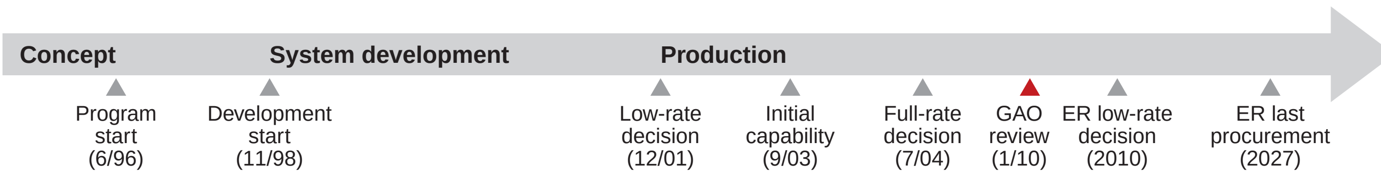
Program Office Comments

In commenting on a draft of this assessment, the H-1 Upgrades Program Office stated it is currently taking delivery of low-rate initial production UH-1Y and AH-1Z aircraft in accordance with its production ramp plan. 52 UH-1Y and 21 AH-1Z aircraft are on contract and the last 13 aircraft deliveries were ahead of contract schedule. AH-1Z risk reduction testing is complete and the AH-1Z Operational Evaluation (OPEVAL) begins in spring 2010. Previously noted deficiencies with Target Sight System, rocket gas ingestion, helmet mounted sight system, and mission software have been corrected and will be formally assessed in the spring 2010 OPEVAL. A subsequent full-rate production decision for the AH-1Z is planned for first quarter, fiscal year 2011. The UH-1Y is in full-rate production and is deployed in Operation Enduring Freedom, performing at three times normal aircraft operating rates.

Joint Air-to-Surface Standoff Missile (JASSM)

JASSM is a long-range Air Force air-to-ground precision missile that will be able to strike targets from a variety of aircraft. The Air Force is producing a baseline JASSM and developing a JASSM-Extended Range (ER) variant, which will provide greater range. Each missile will have separate milestone decision reviews and budgets. The missile's hardware is 70 percent common and its software is 95 percent common. We assessed both variants.

Source: Integrated Test 2 accomplished December 2006.



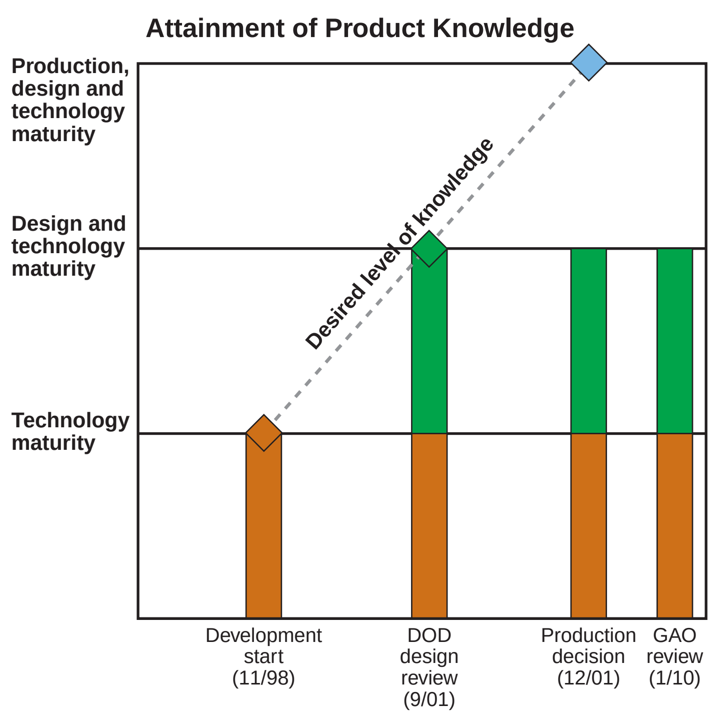
Program Essentials

Prime contractor: Lockheed Martin
Program office: Eglin AFB, FL
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 11/1998	Latest 08/2009	Percent change
Research and development cost	$994.7	$1,317.2	32.4
Procurement cost	$1,240.5	$4,451.5	258.9
Total program cost	$2,259.0	$5,768.7	155.4
Program unit cost	$.915	$1.152	26.0
Total quantities	2,469	5,006	102.8
Acquisition cycle time (months)	75	87	16.0

The JASSM program has a history of cost growth, due primarily to reliability issues with the baseline JASSM and the addition of JASSM-ER to the program. The program experienced a Nunn-McCurdy unit cost breach of the critical threshold in 2007 and was restructured in 2008. The baseline JASSM entered production in 2001 with mature technologies and a design that appeared stable. Since then, however, the missile has demonstrated inconsistent reliability. In 2009, the Air Force stopped accepting delivery of baseline missiles and delayed negotiations on the Lot 8 production contract after 4 out of 10 missiles failed during flight tests conducted from November 2008 through February 2009. Subsequent flight tests completed in October 2009 exceeded reliability goals. A JASSM-ER production decision is expected in fiscal year 2010.



JASSM Program

Technology Maturity

According to the JASSM program office, the three critical technologies for the baseline JASSM and JASSM-ER—global positioning system anti-spoofing receiver module, composite materials, and stealth / signature reduction—have been mature since the start of production in 2001. Consistent with DOD acquisition policy, JASSM-ER is undergoing a technology readiness assessment to support its planned fiscal year 2010 production decision.

Design Maturity

The JASSM program will not achieve design stability until it can consistently demonstrate that the missile can perform reliably. To address reliability issues, the program has made design changes and will retrofit about half of the baseline missiles already delivered. DOD has also made changes to the way the program oversees the prime contractor. JASSM was initiated as a Total System Performance Responsibility program, under which all drawings were developed and managed by the contractor. Following the program's Nunn-McCurdy unit cost breach of the critical threshold in 2007, DOD directed the program to improve its oversight and control over the missile's configuration management.

Production Maturity

Since the full-rate production decision for the baseline JASSM in 2004, missile lot to lot reliability rates have been inconsistent. Recent Lot 5 test results raised concerns about the maturity and quality of the program's manufacturing process. Independent reviews have found that JASSM's reliability issues are primarily driven by supplier quality control problems. The JASSM program stopped accepting deliveries of missiles in both 2007 and 2009 because of test failures and reliability concerns. Specifically, in 2009, the Air Force stopped accepting delivery of baseline missiles and delayed negotiations on the Lot 8 production contract after 4 out of the 10 missiles failed during flight tests conducted from November 2008 through February 2009. Subsequent flight tests completed in October 2009 have achieved a 94 percent reliability rate.

Other Program Issues

The Air Force has 1,053 JASSM baseline missiles on contract (Lots 1-7) and 800 have been delivered to date. The program plans to retrofit at least 389 missiles to improve their reliability. Even though the missiles are covered by a system performance warranty, under which the contractor guarantees their performance for 15 years, the retrofit process and various reliability improvements not covered by the warranty have the potential to cost the Air Force an estimated $18 million to $23 million, according to the progam office. In addition, the retrofit process itself could introduce new reliability issues. All four flight test failures from November 2008 through February 2009 involved missiles that had been retrofitted. The program now plans to use Lot 6 reliability tests to validate improvements to the retrofit process. Air Force testing will determine if $18 million to $23 million in additional retrofits is necessary.

JASSM-ER development, which began in late 2003, is almost complete. The missile continues testing in fiscal year 2010. The program will undergo an operational assessment based on all test results to date, and it will complete a system-level production readiness review to support its low-rate initial production decision scheduled for late fiscal year 2010.

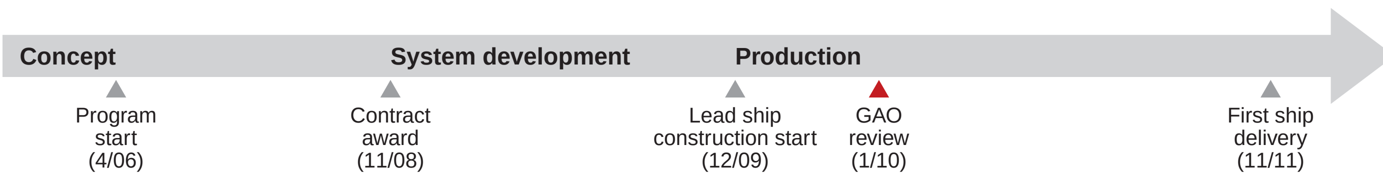
Program Office Comments

The program office provided technical comments on a draft of this assessment, which were incorporated as appropriate.

Joint High Speed Vessel (JHSV)

The JHSV is a joint Army and Navy program to acquire a high-speed, shallow-draft vessel for rapid intratheater transport of combat-ready units. The ship will be capable of operating without reliance on shore based infrastructure. The program awarded a detail design and construction contract with options for nine additional ships to Austal USA in November 2008, and DOD authorized construction of the first ship in December 2009.

Source: Austal USA.



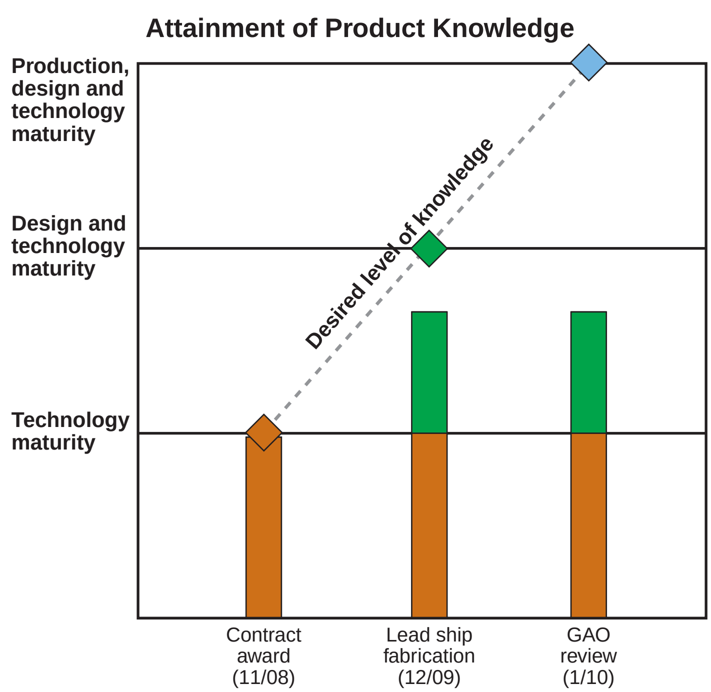
Program Essentials

Prime contractor: Austal, USA
Program office: Washington, DC
Funding needed to complete:
R&D: $24.1 million
Procurement: $1,171.2 million
Total funding: $1,195.3 million
Procurement quantity: 7

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 12/2009	Percent change
Research and development cost	NA	$119.2	NA
Procurement cost	NA	$1722.3	NA
Total program cost	NA	$1,841.5	NA
Program unit cost	NA	$184.152	NA
Total quantities	NA	10	NA
Acquisition cycle time (months)	NA	77	NA

DOD authorized JHSV lead-ship construction in December 2009. While all 18 critical technologies were mature, only 65 percent of the ship's 3D product model was complete. The program office believes that product model completion is less critical for the JHSV because it is not as complex as other Navy ships, such as the DDG 1000 or the T-AKE. Before production began, the shipbuilder also demonstrated its supplier base was stable and its manufacturing processes were in control as required by the Office of the Secretary of Defense. Further, program officials stated that the shipbuilder successfully built a pilot JHSV module in its new modular manufacturing facility, which demonstrated its production readiness. Workforce issues could negatively affect JHSV production. The shipbuilder will have to hire a significant number of skilled workers if its workload increases as anticipated.



JHSV Program

Technology Maturity

The JHSV program awarded its detailed design and construction contract in November 2008 with 17 of its 18 critical technologies mature and demonstrated in a realistic environment. Before production began in December 2009, the program was required to demonstrate that all JHSV critical technologies were mature. According to program officials, the final technology, the high expansion foam firefighting system, completed testing in an operational environment and demonstrated its maturity in November 2009.

Design and Production Maturity

In December 2009, DOD authorized the shipbuilder to start JHSV lead ship construction with 65 percent of the ship's 3D product model complete. According to program officials, the product modeling is complete for some of the JHSV's most complex modules, including the machinery, water jet, and generator rooms. The decision to authorize construction is not consistent with GAO recommended shipbuilding best practices, which call for achieving a complete and stable 3D product model before construction begins. The program office believes that the completion of the model prior to construction start is less critical for its program because the JHSV is not as complex as other Navy ships, such as the DDG 1000 or the T-AKE. The Navy also demonstrated JHSV design maturity by tracking the number of critical drawings approved by the American Bureau of Shipping (ABS). As of December 2009, ABS has approved 99 percent, or 319 out of 321, of JHSV's critical design drawings used to build the 3D product model.

Program officials estimate that 70 percent of the JHSV design is the same as the commercial Hawaii Superferry produced by the JHSV shipbuilder. However, the differences, which include the firefighting system, hotel services, aviation accessibility, and the addition of a limited self-defense capability, affect a large area of the JHSV. The Navy is reviewing dynamic load analysis to ensure safety of the ship. In addition, the program fulfilled the requirement set by the Office of the Secretary of Defense to demonstrate that all JHSV critical technologies were mature, its supplier base was stable, and its manufacturing processes were in control prior to the beginning of construction in December 2009.

In order to achieve the necessary production rate, the shipbuilder built a modular manufacturing facility, which marks a change in production strategy for the yard. Prior to using this facility to build the JHSV, the shipbuilder built components of the Littoral Combat Ship in the facility. In addition, it built a pilot JHSV module in the facility prior to lead-ship construction start. While modular manufacturing decreases the number of workers needed, the contractor experienced hiring issues and program officials anticipate that the shipyard will be challenged to hire a sufficient number of workers with critical skills as its workload increases.

Other Program Issues

The Office of the Secretary of Defense chose the JHSV to participate in the Capital Budget Account Pilot Program, which was created to control cost growth by providing stable funding. Under this program, the program office must gain approval from the Joint Chiefs of Staff, Office of Undersecretary of Defense Acquisition, Technology and Logistics and the Office of the Undersecretary of Defense Comptroller for changes in funding or requirements.

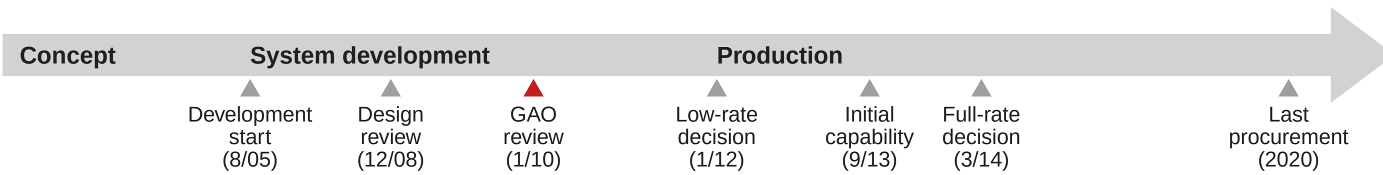
Program Office Comments

The program office provided technical comments, which were incorporated as appropriate. Program officials also stated that in accordance with Section 124 of the National Defense Authorization Act for fiscal year 2008 (Pub. L.No.110-181), the Secretary of the Navy certified that the results of the JHSV production readiness review support commencement of construction of Fortitude (JHSV 1), lead ship of the JHSV class. They stated that the program exceeded its exit criteria by completing greater than 85 percent of all production design efforts, which include preliminary design products, functional design products, 3D computer-aided modeling, ABS reviews of critical design products, and production information, prior to the start of construction in late 2009.

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

The Army's JLENS is designed to provide over-the-horizon detection and tracking of land-attack cruise missiles and other targets. The Army is developing JLENS in two spirals. Spiral 1 is complete and served as a test bed to demonstrate the initial concept. Spiral 2 consists of two aerostats with advanced sensors for surveillance and tracking as well as mobile mooring stations, communication payloads, and processing stations. JLENS provides surveillance and engagement support to other systems, such as PAC-3 and MEADS. We assessed Spiral 2.

Source: JLENS Product Office.



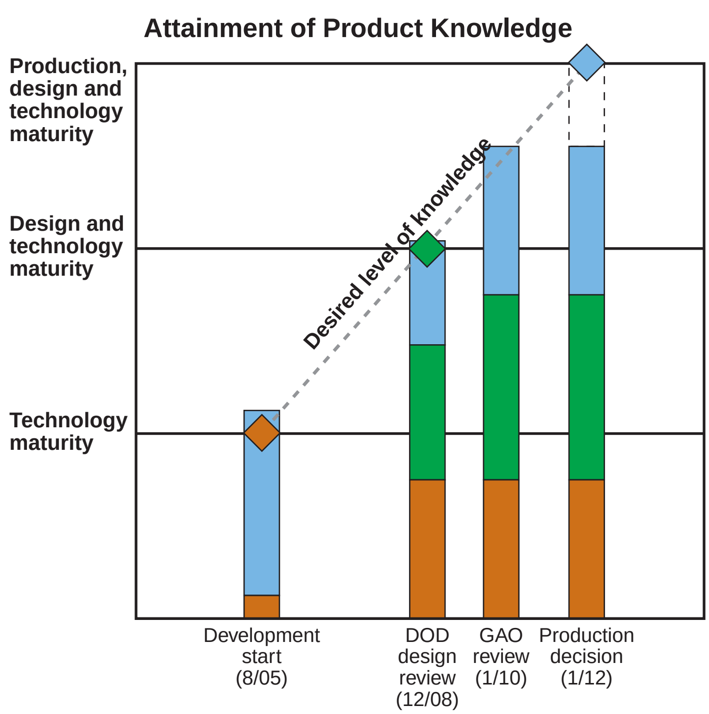
Program Essentials

Prime contractor: Raytheon
Program office: Huntsville, AL
Funding needed to complete:
- R&D: $995.7 million
- Procurement: $4,680.7 million
- Total funding: $5,914.9 million
- Procurement quantity: 14

Program Performance (fiscal year 2010 dollars in millions)

	As of 08/2005	Latest 05/2009	Percent change
Research and development cost	$1,956.0	$2,171.3	11.0
Procurement cost	$4,475.9	$4,680.7	4.6
Total program cost	$6,501.9	$7,067.3	8.7
Program unit cost	$406.372	$441.709	8.7
Total quantities	16	16	0.0
Acquisition cycle time (months)	97	98	1.0

While the JLENS program began with less technology knowledge than suggested by best practices, it is projected to enter production in 2012 with mature technologies, a stable design, and proven production processes. The program began development in 2005 with one of its five critical technologies mature. The program expects all four of its technologies to be mature, but additional design work could be necessary as a result of testing and the expected inclusion of a new armor requirement. Twelve of the program's 15 critical manufacturing processes are currently in control and the program expects all 15 to be mature and stable by the start of production. The JLENS program's cost and schedule could be negatively affected by Army efforts to synchronize it with the Integrated Air and Missile Defense (IAMD) program.



JLENS Program

Technology Maturity

JLENS entered system development in August 2005 with only one of its five critical technologies mature. The program subsequently combined two of the critical technologies—the communications payload and the processing group—into the communications processing group. Two of the program's four current critical technologies are mature and the program office expects to demonstate the fire control radar and surveillance radar in a realistic environment by late 2010. Many of the JLENS radar technologies have legacy components. However, key hardware, such as the surveillance radar's element measurement system that provides data for signal processing, have not been demonstrated in the size and weight needed for integration on the JLENS aerostat. In addition, sensor software items related to signal processing, timing, and control, as well as element measurement, are not yet mature. The program office is currently conducting tests to characterize and integrate the fire control radar and surveillance radar components in the program's system integration laboratory.

Design Maturity

The JLENS program completed its design review in December 2008. Since then, the number of design drawings has grown by over 20 percent. The program has released 100 percent of the 7,573 engineering drawings, and the program office does not expect further drawing increases before production begins in 2012. Although the JLENS design appears stable, the potential for design changes remains until the maturity of JLENS components have been demonstrated. For example, the JLENS program continues to define, develop, and design the mobile mooring station used to anchor the aerostat during operations. Although the mobile station is based on a fixed mooring station design, the program has yet to demonstrate its mobility. The mobile mooring transport vehicle is still being designed and the program office expects the survivability requirements for the vehicle to change. This may require the program to add armor to the vehicle. According to program officials, the combined weight of the mooring station and an up-armored vehicle would exceed the maximum allowed for roads in the United States and in a operational theater.

Production Maturity

The JLENS program projects that it will enter production in January 2012 with all 15 of its critical manufacturing processes mature and stable. According to the program office, 12 of the program's critical manufacturing processes are currently in control.

Other Program Issues

The cost and schedule of the JLENS program could be negatively affected by the Army's IAMD program. The IAMD program is tasked with developing a standard set of interfaces between systems such as JLENS and other sensors, weapons, and the battle management, command, control, communications, computers, and intelligence components to provide a common air picture. As part of the IAMD strategy, the Army plans to extend the system development and demonstration phase of the JLENS program by approximately 12 months and delay low-rate initial production until fiscal year 2012.

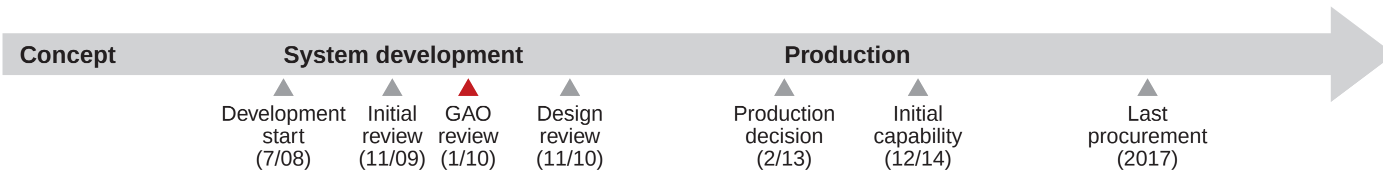
Program Office Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate.

Joint Precision Approach and Landing System

JPALS is a Global Positioning System / Inertial Navigation System–based system that will provide a rapidly deployable, adverse weather, adverse terrain, day-night precision approach and landing capability for all DOD ground and airborne systems. It is a Navy-led joint program with the Air Force and Army. The sea-based JPALS will replace the obsolete SPN-46 and SPN-35 systems. We assessed Increment 1A, which includes the development, integration, installation, and testing of the sea-based JPALS.

Source: PMA 213 Progam Executive Office.



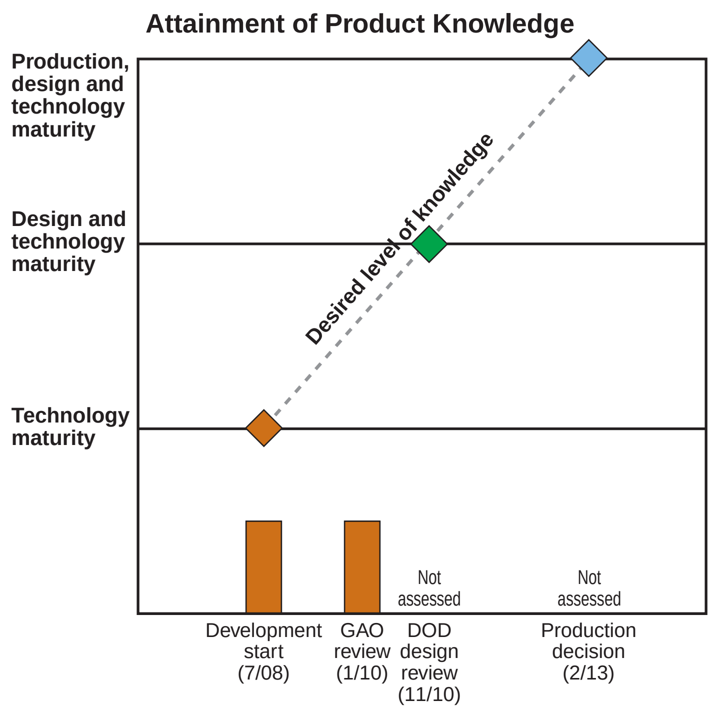
Program Essentials

Prime contractor: Raytheon
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $438.8 million
- Procurement: $208.0 million
- Total funding: $646.8 million
- Procurement quantity: 25

Program Performance (fiscal year 2010 dollars in millions)

	As of 07/2008	Latest 12/2008	Percent change
Research and development cost	$772.6	$772.6	0.0
Procurement cost	$208.0	$208.0	0.0
Total program cost	$987.3	$987.3	0.0
Program unit cost	$26.684	$26.684	0.0
Total quantities	37	37	0.0
Acquisition cycle time (months)	75	77	2.7

Both of the JPALS critical technologies were approaching maturity at the start of system development and are expected to be mature by the program's low-rate production decision in 2013. JPALS is primarily a software development effort and does not currently have design drawings. However, leading up to the November 2010 critical design review, the program office is tracking requirements and weapon system specification changes to monitor design stability. As of January 2009, there were 361 requirements in the system performance specification—an increase of 7 since development start. A second increment of JPALS, Increment 1B, for the F/A18E/F, EA-18G, and MH-60 will begin development in fiscal year 2010.



JPALS Program

Technology Maturity

Both of the JPALS critical technologies were approaching maturity at the start of system development in July 2008. According to the program office, the Geometry Extra-Redundant Almost Fixed Solution addresses errors associated with the system's Global Positioning System. The program office stated that the Vertical Protection Level / Lateral Protection Level calculates the protection level of the navigation system to ensure accurate aircraft landings, and is an existing technology used on fixed locations that now will be applied to moving ships. Program officials expect both technologies to be mature by production in 2013.

Design Maturity

JPALS is primarily a software development effort and does not currently have design drawings. Prior to its November 2010 critical design review, the program is tracking requirements and weapon system specification changes to monitor design stability. As of January 2009, there were 361 requirements in the system performance specification—an increase of 7 since the start of development. The program has not yet released any software. Program officials stated that they are still defining software requirements and that software coding has yet to begin.

Although the program reported that it is currently on track to meet all its key performance parameters, officials noted one design risk that it is still working to address. Specifically, the shipboard system currently requires maintenance every 224 hours—well short of the required 590 hours, although repair times are approximately 25 percent lower than required. Minimizing corrective maintenance activity on the JPALS system is key to minimizing system operating and maintenance manpower—a key performance parameter of the system. Program officials said that design changes may be needed if the antenna is moved to accommodate needed maintenance activities.

Production Maturity

Program officials plan to employ various techniques to assess production maturity, including tool design and fabrication metrics, as well as quarterly production assessment reviews. The program also expects to assess six functional areas: program management, engineering production and design, production engineering and planning, materials and purchase parts, industrial resources, and quality assurance. The program expects to receive approval to enter production in February 2013.

Other Program Issues

According to program officials, the system development phase of the JPALS program was initially delayed by three months due to a bid protest of the development contract award. However, the protest was subsequently withdrawn and officials maintain that the overall cost and schedule of the program was not affected. Officials also reported that the program completed preliminary design review in December 2009 and the independent panel found the technical baseline meets program requirements and is at the proper maturity to begin detailed design with no significant changes anticipated.

The acquisition strategy separates the JPALS program into two increments. The second increment of JPALS, Increment 1B, will integrate the system with the avionics of the F/A18E/F, EA-18G, and MH-60R. Increment 1B will begin development in fiscal year 2010.

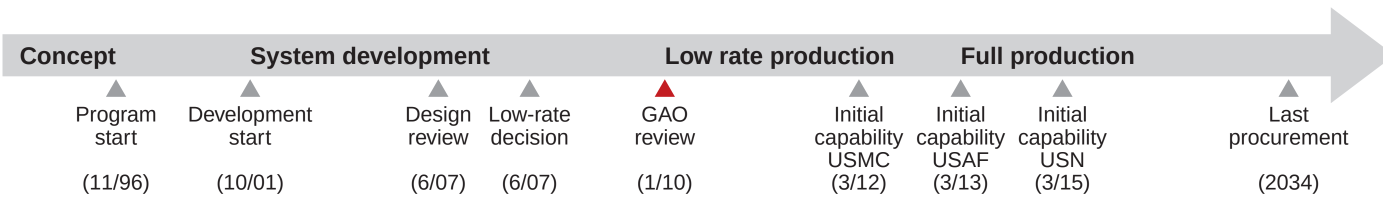
Program Office Comments

The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

Joint Strike Fighter

The JSF program will develop and field a family of stealthy strike fighter aircraft for the Air Force, Marine Corps, Navy, and U.S. allies, with the goal of maximizing commonality to minimize costs. The carrier-suitable variant will complement the Navy's F/A-18E/F. The conventional takeoff and landing variant will primarily be an air-to-ground replacement for the Air Force's F-16 and A-10 aircraft, and will complement the F-22A. The short takeoff and vertical landing variant will replace the Marine Corps' F/A-18 and AV-8B aircraft.

Source: Lockheed Martin.



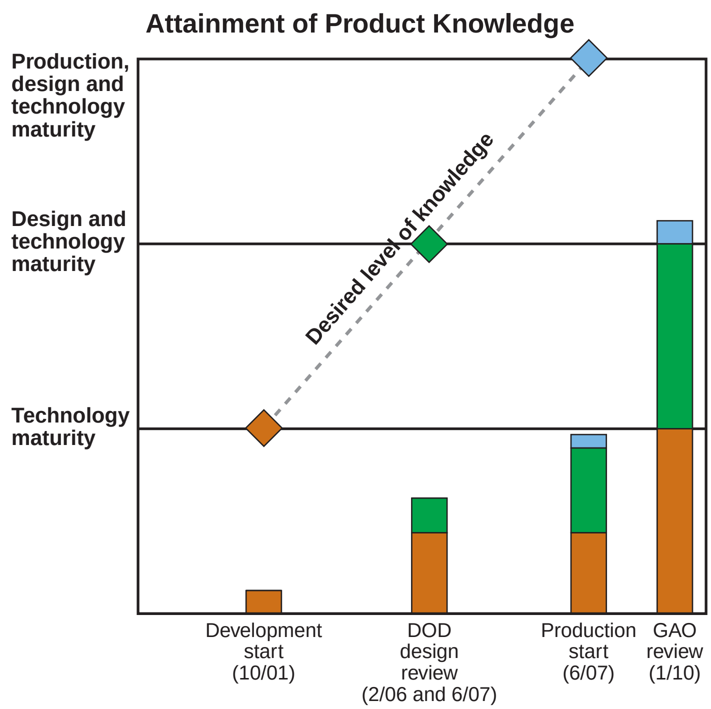
Program Essentials

Prime contractor: Lockheed Martin
Program office: Arlington, VA
Funding needed to complete:
R&D: $7061.7 million
Procurement: $192,093.9 million
Total funding: $199,499.2 million
Procurement quantity: 2,413

Program Performance (fiscal year 2010 dollars in millions)

	As of 10/2001	Latest 08/2009	Percent change
Research and development cost	$38,022.4	$47,309.5	24.4
Procurement cost	$168,687.5	$199,412.8	18.2
Total program cost	$208,475.6	$247,221.3	18.6
Program unit cost	$72.741	$101.196	39.1
Total quantities	2,866	2,443	-14.8
Acquisition cycle time (months)	116	137	18.1

The JSF program has not demonstrated key knowledge by critical points in the acquisition process. Program officials report that all eight critical technologies are mature; however, development risks remain on two technologies. Officials also report that more than 99 percent of the expected engineering drawings have been released, but the number of drawings continues to grow and the design has not been proven. The program collects data to monitor its critical manufacturing processes, but only a small percentage of them are in control. In addition, a fully integrated, capable aircraft will not begin flight testing until 2012, increasing the likelihood of costly redesign and retrofit. In October 2009, an independent cost estimating team reported that the program has made little progress over the past year and will need more time and money to finish development.



JSF Program

Technology Maturity

The JSF program entered system development with none of its eight critical technologies fully mature. While the program office currently reports that all eight technologies are mature, significant development risks still remain on two technologies—mission systems integration and the prognostics and health management system. Full mission systems integration will not be demonstrated on an F-35 test aircraft until 2012. In addition, a 2009 operational assessment by the Air Force Operational Test and Evaluation Center reported that the prognostics and health management technology was immature. With an immature prognostics and health management system, maintainers may not be able to correctly diagnose and repair aircraft faults in a timely manner resulting in reduced aircraft usage and higher support costs.

Design Maturity

The JSF program did not have a stable design at its critical design review. Since then, it has released over 99 percent of the expected engineering drawings; however, the design is still not proven. The program continues to experience numerous design changes as system development and manufacturing progresses. Design changes to the turbine blades, electrical ice protection, and fuel pump systems on the F-135 engine have contributed to contract cost increases of more than $800 million.

Production Maturity

Despite beginning production in 2006 and procuring 28 aircraft to date, the JSF program's manufacturing processes are still not mature. While the program collects information on the maturity of its manufacturing processes—a good practice—only 12.5 percent of its critical manufacturing processes are in statistical control. Ongoing design issues and subsequent supplier problems have led to late part deliveries and manufacturing inefficiencies from which the program is still recovering. The contractor has restructured the manufacturing schedule three times, significantly delaying deliveries to the test program and raising questions about its ability to meet planned production schedules. Projected labor hours still exceed early projections and out-of-station work, which is carried forward from its designated station and completed at a different station down the production line, continues. Officials do not expect inefficiencies to be corrected until 2010, during the third low rate production lot.

Delays in delivering development test aircraft have led to worsening flight test delays. As of December 2009, only 4 out of a planned 13 development test aircraft had flown and developmental flight testing is still only about 3 percent complete. In addition, a fully integrated, capable aircraft is not expected to enter flight testing until 2012, increasing the risk of late design and production changes and the likelihood that retrofits will be required.

Other Program Issues

An updated independent cost estimate, completed in October 2009, reported that significantly more time and money would be needed to complete system development. Current contractor engineer staff levels are higher than predicted by the program office and the independent cost team last year. Manufacturing inefficiencies have seen little improvement and the late delivery of flight test aircraft continues. In addition, while the JSF program is producing software at higher rates than past programs, the overall software effort is behind schedule and some of the program's most challenging software integration efforts are yet to come.

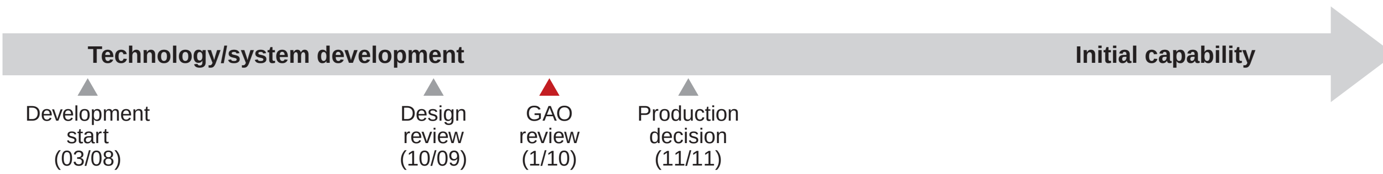
Program Office Comments

The program noted that the JSF's technical, software, production processes, and testing maturation are tracking to plan and substantially exceed standards set in past programs. While production of initial test jets has taken longer than planned, the manufacturing fit and quality are unprecedented and production processes are improving with each jet. The aircraft's design is 100 percent complete. By the completion of the fourth low-rate initial production lot, thousands of flight-test hours will be complete. Thus far, laboratory models have strongly correlated to actual flight test data. Software development is 80 percent complete (over 14 million lines) in accordance with the spiral development plan and with record-setting code-writing efficiencies. Systems integration testing continues on schedule through the use of flight tests, a flying lab, and over 150,000 hours of ground lab testing. A fully integrated mission systems jet is scheduled to fly in 2010. The program is on track to start training operations at Eglin AFB, Florida, in late summer 2010.

Joint Tactical Radio System Airborne, Maritime, Fixed-Station (JTRS AMF)

DOD's JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. A joint program executive office provides a central acquisition authority that cuts across the military services. Program and product offices develop hardware and software for users with similar requirements. The AMF program will develop radios and associated equipment for integration into nearly 160 different types of aircraft, ships, and fixed stations.

Source: JTRS AMF Program Office.



Program Essentials

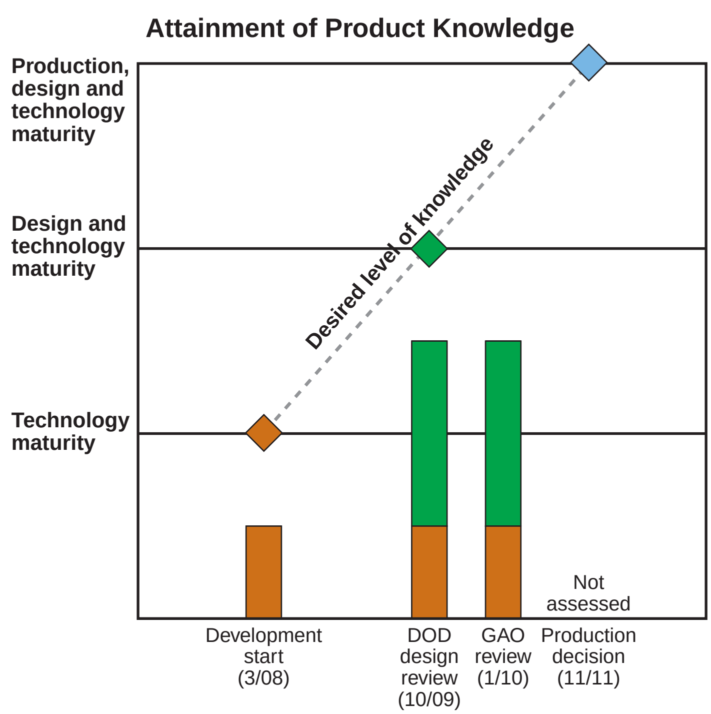
Prime contractor: Lockheed Martin Corp.
Program office: San Diego, CA
Funding needed to complete:
R&D: $1,319.5 million
Procurement: $6,129.8 million
Total funding: $7,449.3 million
Procurement quantity: 26,878

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 08/2009	Percent change
Research and development cost	NA	$1,968.6	NA
Procurement cost	NA	$6,129.8	NA
Total program cost	NA	$8,098.4	NA
Program unit cost	NA	$.299	NA
Total quantities	NA	27,102	NA
Acquisition cycle time (months)	NA	NA	NA

The program office reported quantities in terms of channels rather than radios. The program is developing a 2-channel small airborne radio and a 4-channel maritime/fixed station radio.

According to an independent technology readiness assessment, the JTRS AMF program began system development in March 2008 with all five critical technologies nearing maturity and demonstrated in a relevant environment. The JTRS AMF design appears stable with nearly 94 percent of the total expected drawings releasable when the program began its design review process in October 2009. Each of the AMF variants will undergo initial operational test and evaluation after the program's low-rate initial production decision. Testing of the small airborne variant is scheduled from October 2012 to December 2013 and testing of the maritime/fixed-station variant is scheduled from May 2013 to March 2014. JTRS AMF quantities could change depending on the Navy and Marine Corps' strategy for acquiring networking capabilities.



JTRS AMF Program

Technology Maturity

DOD certified the JTRS AMF program for entry into system development in March 2008 with all five critical technologies nearing maturity and demonstrated in a relevant environment. Prior to the start of system development, the JTRS AMF program took steps to develop key product knowledge. In 2004, the program awarded competitive system design contracts to two industry teams led by Boeing and Lockheed Martin to help mitigate technical risks and address key integration challenges. Program officials noted that another independent assessment of critical technologies will be performed in preparation for the small airborne variant low-rate initial production milestone of November 2011.

The Under Secretary of Defense for Science and Technology has expressed concern about four waveforms and network management services technologies being developed by the JTRS Network Enterprise Domain program, on which JTRS AMF is dependent. To address this concern, the Under Secretary recommended that the JTRS joint program executive office conduct an independent technical assessment of the Network Enterprise Domain's waveforms, networking, and network management approaches. The Under Secretary also recommended that a similar assessment be conducted on the Mobile User Objective System waveforms and network management software to demonstrate their maturity before being inserted into the JTRS AMF program. According to program officials, these recommendations will be implemented by the JTRS Network Enterprise Domain program in future technical evaluations.

Design Maturity

The JTRS AMF design appears stable. According to program officials, nearly 94 percent of the total expected drawings were releasable by the October 2009 design review. The results of the design review are scheduled for release in early 2010. While the design appears stable, JTRS AMF's ability to demonstrate that the system meets its performance requirements is dependent on waveforms and network management services from the JTRS Network Enterprise Domain program. Each of the JTRS AMF variants will undergo initial operational test and evaluation after the program's low-rate initial production decision. Testing of the small airborne variant is scheduled from October 2012 to December 2013 and testing of the maritime/fixed-station variant is scheduled from May 2013 to March 2014.

Other Program Issues

Updated draft fielding plans are expected from the services in fiscal year 2010, and the updated fielding plans will require the preparation of updated Joint Programming Guidance from the Office of the Director, Cost Assessment and Program Evaluation to be finalized. JTRS AMF quantities could change depending on the Navy and Marine Corps' strategy for acquiring networking capabilities. The total planned procurement of small airborne radios is 8,641. The Army and Air Force plan to buy 5,664 and 2,977 small airborne radios, respectively. However, a March 2008 JTRS AMF acquisition decision memorandum stated that neither the Navy nor the Marine Corps have a requirement for the small airborne JTRS AMF radio. The lack of a requirement indicates that the Navy and Marine Corps plan to rely on the ARC-210 radio for their airborne communications needs. While the ARC-210 radio is being upgraded, it will not have the waveforms for air-to-air and air-to-ground data networking. In August 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics directed the JTRS joint program executive office, the Office of the Assistant Secretary of Defense for Networks and Information Integration (NII), along with the Joint Staff and military services, to assess issues and options related to replacing currently fielded ARC-210 radios with JTRS AMF capabilities. According to an NII official, this assessment has not been initiated.

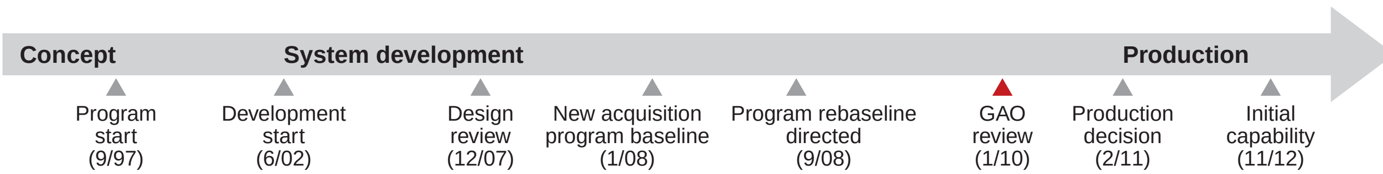
Program Office Comments

In commenting on our draft, the program office generally concurred with our findings and offered technical comments for our consideration. We incorporated the technical comments where appropriate.

Joint Tactical Radio System Ground Mobile Radio (JTRS GMR)

DOD's JTRS program is developing software-defined radios that will interoperate with selected radios and increase communications and networking capabilities. The JTRS GMR program is developing radios for ground vehicles. JTRS GMR depends on waveforms being developed by the JTRS Network Enterprise Domain program, and shares interdependencies with the JTRS Handheld, Manpack, Small Form Fit program as well as the JTRS Airborne, Maritime, Fixed-Station program.

Source: JPEO JTRS.



Program Essentials

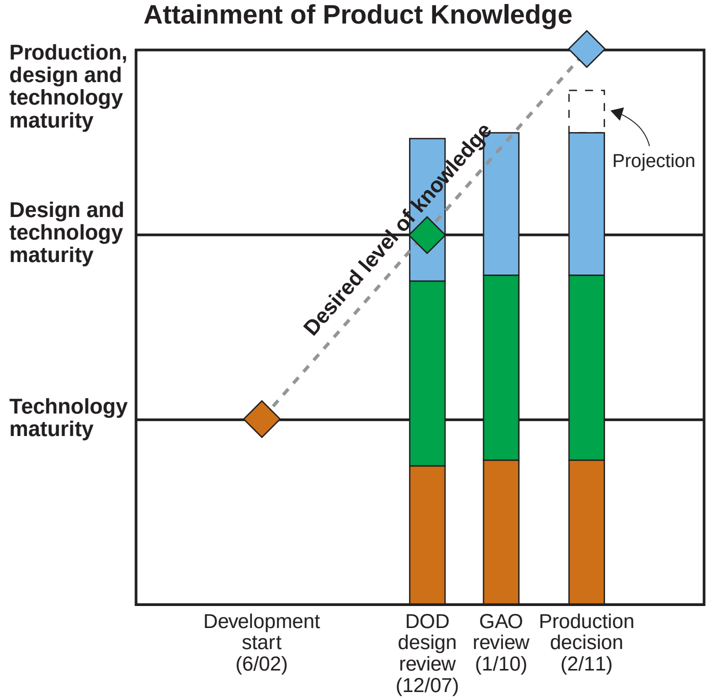
Prime contractor: The Boeing Company
Program office: San Diego, CA
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 06/2002	Latest 08/2009	Percent change
Research and development cost	$994.8	$1,693.0	70.2
Procurement cost	$16,000.1	$14,449.0	-9.7
Total program cost	$16,994.9	$16,142.0	-5.0
Program unit cost	$.157	$.186	18.8
Total quantities	108,388	86,643	-20.1
Acquisition cycle time (months)	55	114	107.3

The JTRS GMR program began system development in 2002 with none of its 20 critical technologies mature and demonstrated in a realistic environment. The program expects that all JTRS GMR critical technologies will be mature, its design will be stable, and most of its production processes will be in control by its expected February 2011 production decision. The cost and quantities of the JTRS GMR program are in flux. In September 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics directed the program to revise its acquisition program baseline and update its cost estimate. However, as of October 2009, a new baseline had not been approved. In addition, changes to the Army's Future Combat System could substantially affect the program, as over 99 percent of the program's anticipated 86,512 production units are expected to go to the Army.

Attainment of Product Knowledge



JTRS GMR Program

Technology Maturity

The JTRS GMR program started system development in 2002 with none of its 20 critical technologies mature and demonstrated in a realistic environment. Twelve of JTRS GMR's 20 critical technologies are now mature, 7 are nearing maturity, and 1 is still immature. The immature critical technology—bridging/retransmission software—is to be evaluated in a realistic environment during the second phase of production qualification testing (PQT), which began in December 2009. The program expects all JTRS GMR critical technologies to be mature before its February 2011 production decision.

Design Maturity

The design of the JTRS GMR appears stable. However, the potential for design changes remains because all of the program's critical technologies have not been demonstrated in a realistic environment. The program held its critical design review in December 2007 and reported that all its design drawings were releasable at that time. The JTRS GMR prime contractor also tracks requirements volatility for hardware and software items as a measure of design stability. Program officials stated that requirements volatility has not exceeded the program's 5 percent goal during the period it has been tracked.

Production Maturity

The JTRS GMR program has reported that 27 of its 35 critical manufacturing processes will be in statistical control by the program's low-rate production decision in February 2011. The identification of critical manufacturing processes is a key initial step to ensuring production elements are stable. However, by not having all processes in statistical control at production start, there is a greater risk that the radio will not be produced within cost, schedule, and quality targets. The JTRS GMR program has delivered 32 engineering development model (EDM) sets for use in PQT, and program officials consider these EDMs to be production representative.

Other Program Issues

The cost and quantities of the JTRS GMR program are in flux. In April 2009, the Secretary of Defense announced plans to significantly restructure the Future Combat System program. The Under Secretary of Defense for Acquisition, Technology and Logistics terminated the existing manned ground combat vehicle development program and the Army is now proceeding with plans to assess potential materiel solutions for a new ground combat vehicle program. Changes to the Future Combat System program could substantially affect JTRS GMR, as over 99 percent of the JTRS GMR's anticipated 86,512 production units are expected to go to the Army. In August 2008, the Under Secretary of Defense for Acquisition, Technology and Logistics completed a review of the overall JTRS program and directed the JTRS GMR program manager to update the program's cost estimate and revise its acquisition program baseline. As of October 2009, a new baseline had not been approved. According to program officials, estimated JTRS GMR program costs have decreased overall due to lower than projected production costs. Program officials stated that expected quantities have not changed, nor has the expected mix of two-, three-, and four-channel radios to be procured. Current program office estimates of total research and development costs are $279 million higher than last year's estimates. However, the testing schedule has slipped 3 months and the program's production decision has been delayed until February 2011. The Army's Infantry Brigade Combat Team (IBCT) program used three GMR engineering development models and seven pre-engineering development models to support the Early IBCT LUT in August 2009. According to DOD's Director, Operational Test and Evaluation, the LUT assessment indicated operational reliability issues and poor performance from the JTRS GMR subsystem.

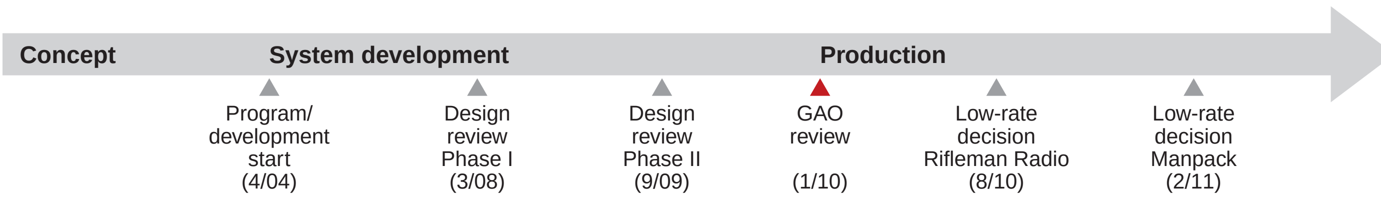
Agency Comments

In commenting on a draft of this assessment, the JTRS Joint Program Executive Office provided technical comments, which were incorporated as appropriate.

JTRS Handheld, Manpack, Small Form Fit (JTRS HMS)

The JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. JTRS HMS is developing handheld, manpack, and small form fit radios. The program has two concurrent phases of development. Phase 1 includes handheld and small form fit radios for use in an unclassified security domain. Phase 2 consists of the manpack, handheld, and small form fit radios for use in a classified security domain. We assessed Phase 1 and made observations on Phase 2.

Source: © 2009 General Dynamics.



Program Essentials

Prime contractor: General Dynamics C4 Systems
Program office: San Diego, CA
Funding needed to complete:
- R&D: $167.8 million
- Procurement: $2,526.7 million
- Total funding: $2,694.6 million
- Procurement quantity: 215,551

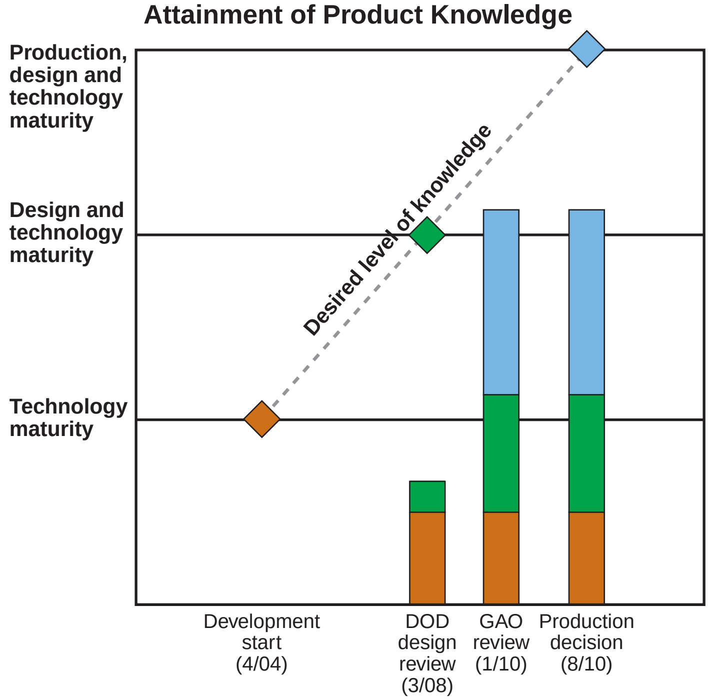
Program Performance (fiscal year 2010 dollars in millions)

	As of 05/2004	Latest 12/2009	Percent change
Research and development cost	$531.3	$844.4	58.9
Procurement cost	$9,259.6	$2,526.7	-72.7
Total program cost	$9,790.9	$3,371.1	-65.6
Program unit cost	$.030	$.016	-47.5
Total quantities	329,574	215,961	-34.5
Acquisition cycle time (months)	85	99	16.5

Total quantities include the Army's requirement for 120,000 Rifleman Radio units.

The two JTRS HMS Phase 1 critical technologies are nearing maturity and have been demonstrated in a relevant environment. The program expects to formally identify critical technologies for Phase 2 by the second quarter of fiscal year 2010. The program has completed design reviews for both phases, although neither design is stable. Designing the Phase 2 two-channel handheld radio to meet size, weight, power, and thermal requirements continues to be a challenge. Development of this radio has been on hold since September 2008 pending an assessment of alternatives. The key networking waveform for the HMS program, the Soldier Radio Waveform (SRW), recently completed a formal qualification test, and according to the program office, the full version of the waveform will be used in the Rifleman radio. According to the program office, the one JTRS HMS critical manufacturing process is in control.

Attainment of Product Knowledge



JTRS HMS Program

Technology Maturity

The JTRS HMS program started system development in 2004 with only one of its six critical technologies mature. In 2006, the program was restructured to include two concurrent phases of development. Phase 1, which intends to maximize the use of commercial off the shelf components and products, includes two critical technologies—logical partitioning and software power management. The program completed an independent technology assessment in September 2009, which determined these technologies were nearing maturity and had been demonstrated in a relevant environment. In addition, the program is developing the single channel Rifleman Radio in Phase 1 to meet operational requirements. This radio will utilize the SRW waveform, which was developed by the JTRS Network Enterprise Domain program office to support protected communications within fire teams and squads.

The JTRS HMS program expects that critical technologies for Phase 2, which includes the security-enhanced handheld and manpack variants, will be formally identified by the second quarter of fiscal year 2010. The development of the Phase 2 two-channel handheld radio continues to pose a significant risk for the program. The risk stems from trying to meet size, weight, power, and thermal requirements with current technologies. In September 2008, DOD halted the development of the two-channel handheld radio to assess the viability of the radio, as well as other alternatives. Development of the two-channel handheld radio remains on hold.

Design Maturity

Neither Phase 1 nor Phase 2 designs were stable at their respective design reviews in March 2008 and September 2009. In the last year, the number of Phase I design drawings has increased by 169 due to the development of the Rifleman Radio. The number of Phase 2 design drawings has increased by over 750 due in part to the added requirement to utilize the Mobile User Objective System (MUOS) waveform with the manpack radio. The number of drawings for Phase 2 will increase again to include the two-channel handheld radio, if its development is allowed to continue.

Production Maturity

According to the program office, the one JTRS HMS critical manufacturing process is mature and in control. Last year, the program identified 24 critical manufacturing processes. The program office explained that the reduction was due to changes in the content of the program and the elimination of key hardware that is no longer manufactured by the prime contractor. In addition, the program office stated that the maturity of JTRS HMS manufacturing processes has been steadily increasing, so processes once deemed critical are now considered either key or standard processes. The JTRS HMS program will utilize visual inspections and testing to assess the maturity of these processes. In addition, according to the program office, all JTRS HMS production processes are equivalent to processes already implemented successfully on other programs.

Other Program Issues

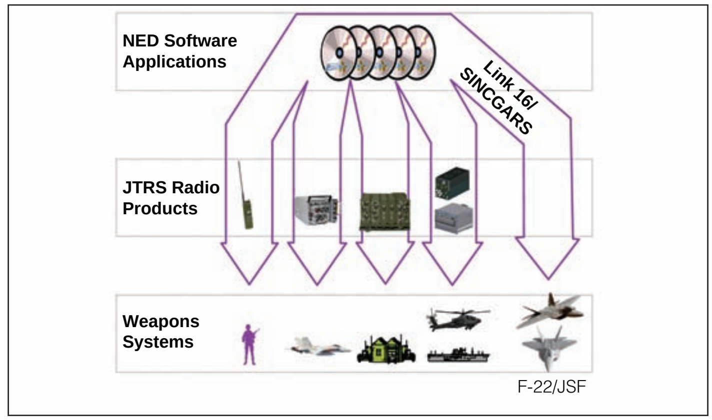
JTRS HMS quantities have increased by 120,000 radios, due to the Army's new requirement for the Rifleman Radio. The addition of a significant number of Rifleman Radios to the program will make it appear as if the overall JTRS HMS unit cost has decreased. As we have previously reported, the unit cost for the HMS program varies significantly by radio from an estimated $4,500 for the Rifleman Radio including ancillaries to about $55,000 for the manpack radio.

Program Office Comments

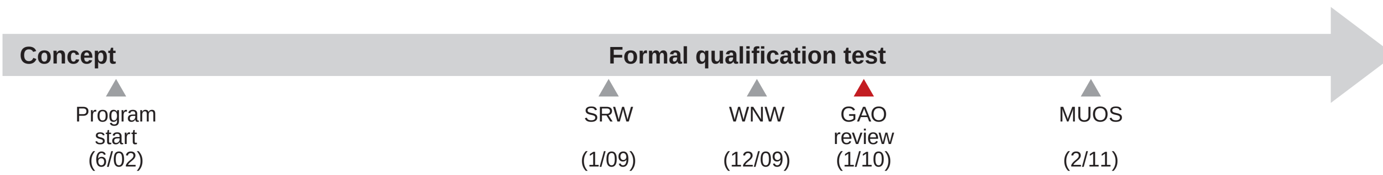
Program officials noted that the Rifleman radio's Low Rate Initial Decision was delayed by 9 months in order to demonstrate the correction of performance deficiencies identified in a Limited User Test that occurred in fiscal year 2009. In addition, the program provided technical comments, which were incorporated as appropriate.

Joint Tactical Radio System Network Enterprise Domain

DOD's JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. A Joint Program Executive Office provides central acquisition authority. The Network Enterprise Domain (NED) is responsible for the development of products or software applications that will operate on the JTRS variants. We assessed the Wideband Networking Waveform (WNW) and Soldier Radio Waveform (SRW), which provide key advanced networking capability.



Source: Network Enterprise Domain Program Office.



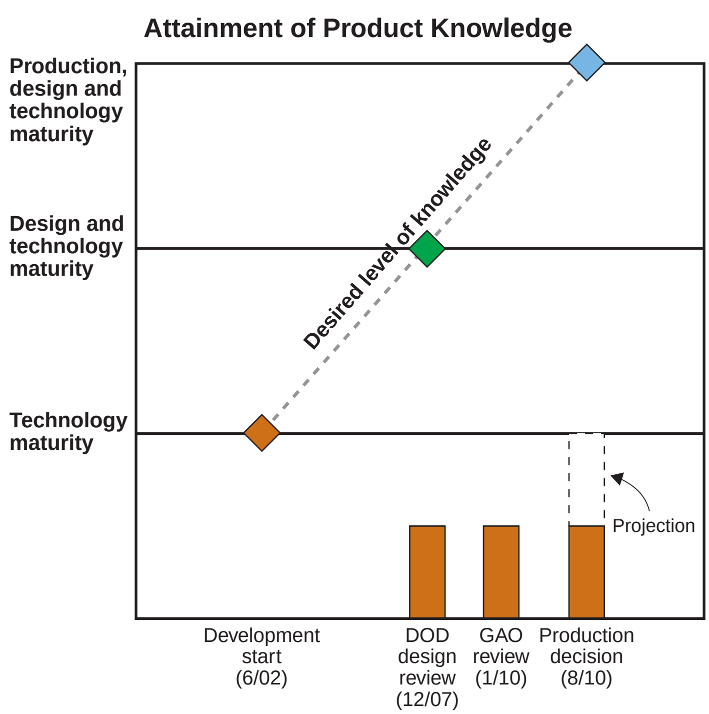
Program Essentials

Prime contractor: Various
Program office: San Diego, CA
Funding needed to complete:
- R&D: $557.0 million
- Procurement: NA
- Total funding: $557.0 million
- Procurement quantity: NA

Program Performance (fiscal year 2010 dollars in millions)

	As of 06/2002	Latest 12/2008	Percent change
Research and development cost	$956.9	$2,018.7	111.0
Procurement cost	NA	NA	NA
Total program cost	$956.9	$2,018.7	111.0
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

The JTRS NED program is responsible for the development of legacy and networking waveforms and Network Enterprise Services for JTRS radios. The one critical technology for both WNW and SRW—the Mobile Ad Hoc Networking—is expected to be fully mature by August 2010. Since NED is a software development effort, it does not have design drawings. Instead, program officials assess waveform design stability using software metrics. Officials reported low requirements and design volatility for both waveforms. In the past year, the program office reported progress in developing and testing both waveforms. SRW passed its formal qualification test in January 2009, and WNW's formal qualification test was completed in December 2009. However, the results of the 30-node test conducted in 2009 with the JTRS Ground Mobile Radios and WNW were mixed.



JTRS NED Program

Technology Maturity

The JTRS NED program began development in 2002 with the one critical technology for both WNW and SRW—Mobile Ad Hoc Networking—immature. This technology is currently nearing maturity and is expected to be fully mature and demonstrated in a realistic environment by August 2010. JTRS NED is a software development effort and the major milestones are formal qualification tests. SRW passed its formal qualification test (FQT) in January 2009. WNW formal qualification testing was successfully completed in December 2009—6 months later than planned. According to the program office, WNW formal qualification testing was delayed to allow for the correction of software deficiencies, as well as full integration testing with a suitable JTRS GMR engineering development model and operating environment.

Design Maturity

We could not assess design stability because the JTRS NED is a software development effort and does not have design drawings. Instead, program officials indicated that waveform design stability and maturity are evaluated using metrics such as waveform requirements and design volatility, software lines of code, and software defect reports. The NED program office has reported that since December 2007, the waveforms show less than 5 percent requirements volatility and less than 1 percent design volatility. In addition, the program has reported maintaining a steady closure rate for software defects for the WNW.

Other Program Issues

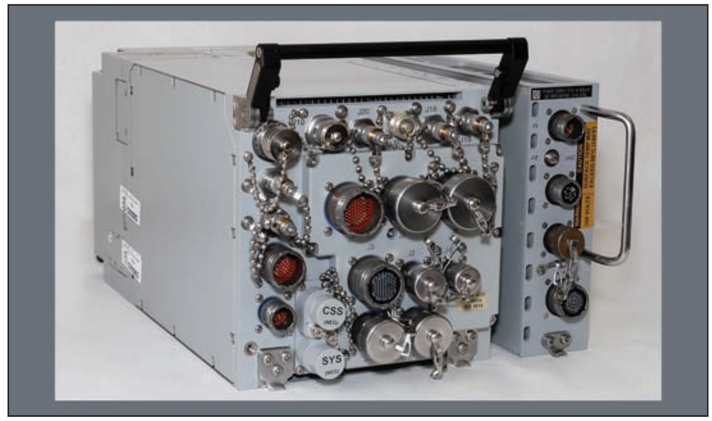
As directed in a September 2008 acquisition decision memorandum, the JTRS Joint Program Executive Office completed a 30-node field test of the WNW and JTRS Ground Mobile Radio in May 2009. DOD's Director of Operational Test and Evaluation concluded that the initial assessment of the test indicates that the preproduction WNW hosted on a JTRS Ground Mobile Radio preliminary engineering development model (Pre-EDM GMR) could scale to a network of 30 nodes, yet performed poorly in the areas of throughput and message completion rate.

Program Office Comments

According to the program office, NED completed a 30-node field test of the WNW Network Manager and WNW using Pre-EDM GMRs in May 2009. The WNW network exhibited practical scalability to 30 nodes in an operationally relevant network topology and provided a tactically useful networking capability in an operationally relevant suburban environment. Convergence was achieved at all networking layers, transporting three different protocols of red-side user traffic. Several software updates were implemented to the WNW code, successfully demonstrating the ability to enhance networking capability while deployed. Performance data collected were analyzed to develop enhanced WNW networking algorithm updates, which were integrated into the final WNW software version that completed FQT in December 2009. This final WNW baseline software version improved performance on GMR Engineering Development Model hardware during the FQT. Program office technical comments were incorporated as appropriate.

Mutifunctional Information Distribution System–Joint Tactical Radio System (MIDS-JTRS)

DOD's MIDS-JTRS program is intended to transform the existing MIDS Low Volume Terminal—a jam-resistant, secure voice and data information distribution system—into a 4-channel, programmable JTRS-compliant radio that will be used in aircraft, ships, and ground stations across the military services. We assessed the development of the MIDS-JTRS core terminal and made observations on the status of the planned JTRS platform capability package, which includes an airborne networking waveform being developed by the JTRS Network Enterprise Domain.



Source: MIDS Program Office.

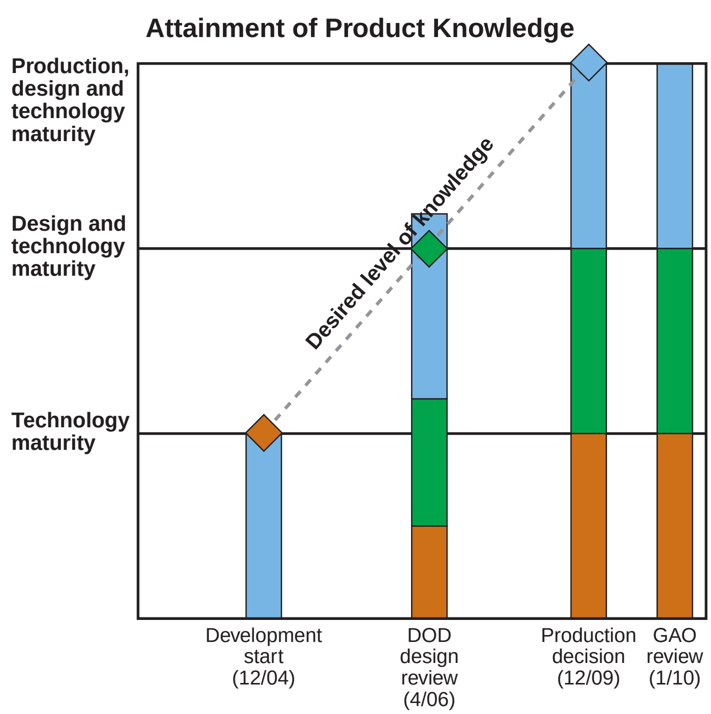
Program Essentials

Prime contractor: Data Link Solutions, ViaSat
Program office: San Diego, CA
Funding needed to complete:
R&D: $18.2 million
Procurement: $129.7 million
Total funding: $147.9 million
Procurement quantity: 179

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2004	Latest 11/2009	Percent change
Research and development cost	$304.0	$491.3	61.6
Procurement cost	$0.0	$216.2	100.0
Total program cost	$304.0	$707.5	132.7
Program unit cost	$9.500	$2.033	-78.6
Total quantities	32	348	987.5
Acquisition cycle time (months)	50	69	38.0

According to the program office, the MIDS-JTRS core terminal had its critical technologies mature, its design stable, and its production processes in control when it entered limited production and fielding in December 2009. In the past year, the production decision was delayed 9 months due primarily to issues in meeting first article qualification testing requirements. Core terminal development models have been integrated into F/A-18E/F aircraft and are undergoing testing in an operational environment to support the limited production and fielding decision. MIDS-JTRS airborne networking waveform development remains on hold. In September 2007, the JTRS Board of Directors suspended the design, development, fabrication, and testing of the JTRS platform capability package pending a determination of whether there were enough potential users among the military services to support this effort.



MIDS JTRS Program

Technology Maturity

The MIDS-JTRS program entered system development with four critical technologies for the core terminal—Link-16 waveform software, Link-16 architectural design, operating environment, and programmable crypto module—that were immature and had only been demonstrated in a lab environment. Unanticipated complexity in integrating these subsystems has caused program schedule delays. According to program officials, the program has been demonstrating the terminal's capabilities in an operational environment and was expected to demonstrate the maturity of the critical technologies by the limited production and fielding decision in December 2009.

Design Maturity

According to program officials, the core terminal's design is stable. Design, integration, and testing challenges have caused delays at several points in the program. The core terminal faced challenges in meeting National Security Agency security requirements. Though it received National Security Agency design concurrence and over-the-air approval in an F/A-18E/F aircraft, understanding and implementing information security criteria caused changes in security design. The effects of the design changes were not adequately scoped into the integration schedule, which contributed to delays in the program's production decision. NSA has approved the security verification testing report for the latest build, but the final build will require additional testing. In the past year, the production decision was delayed another 9 months due primarily to issues with vendors' ability to meet first article qualification testing requirements. Production Verification terminals are on loan to the government to support developmental and operational testing until purchased terminals are delivered.

Production Maturity

The MIDS-JTRS program has demonstrated that its two critical manufacturing processes are mature. Program officials stated that production maturity is high because the core terminal is a form, fit, and function replacement for the MIDS Low Volume Terminal (LVT) and the manufacturing processes are the same as those previously employed.

Other Program Issues

In June 2008, after the MIDS-JTRS program experienced cost growth and continuous schedule delays, a cost cap agreement with incentives was negotiated between the government and MIDS contractors to reduce the government's cost risk to complete the core terminal program. According to DOD, the program's schedule and cost are holding within the agreed cost cap. A new acquisition program baseline will be approved with the MIDS-JTRS low-rate limited production decision. According to the program office, the MIDS Program, which includes MIDS-LVT and MIDS-JTRS variants, will be tracked as a single program in the baseline, but the baseline will identify the MIDS-JTRS variant cost data independently from the MIDS-LVT variant in the unit cost memo section. Program officials estimated that the unit cost for a JTRS terminal during limited production and fielding will be $234,500 higher than the LVT ($425,000 vs. $190,500), but they expect the cost to decrease during full rate production as a result of competition as was the case for the LVT terminal.

MIDS-JTRS airborne networking waveform development has still not been authorized. In September 2007, the JTRS Board of Directors suspended the design, development, fabrication, and testing of the JTRS platform capability package, pending a determination from Joint Staff and Services on the requirements for the future advanced airborne tactical data link. This suspension remains in effect. Further, the Office of the Secretary of Defense, Cost Assessment and Program Evaluation, and the Director, Defense Research and Engineering, co-chaired a study of airborne networking waveforms for integration into the MIDS-JTRS. This study was completed in the fall of 2009. The program office indicates that studies are ongoing to recommend a waveform for integration into the MIDS JTRS terminal.

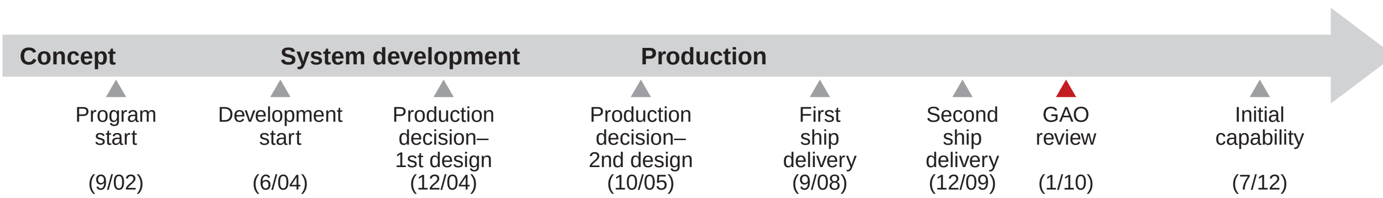
Program Office Comments

In commenting on a draft of this assessment, the MIDS-JTRS program office provided technical comments, which were incorporated as appropriate.

Littoral Combat Ship (LCS)

The Navy's LCS is designed to perform mine countermeasures, antisubmarine warfare, and surface warfare missions. It consists of the ship itself, or seaframe, and the mission package it deploys. The Navy plans to construct the first four seaframes in two unique designs, then select one design for the remainder of the class. The first seaframe (LCS 1) was delivered in September 2008 with the second seaframe (LCS 2) following in December 2009. We assessed both seaframes. See pages 97-98 for an assessment of LCS mission packages.

Sources: Lockheed Martin (left); General Dynamics (right).



Program Essentials

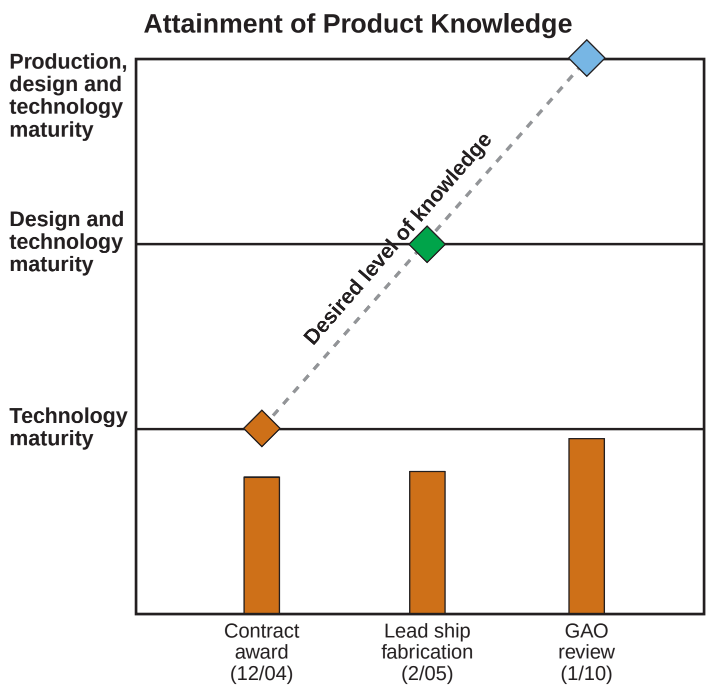
Prime contractor: General Dynamics, Lockheed Martin
Program office: Washington, DC
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 05/2004	Latest 09/2009	Percent change
Research and development cost	$865.2	$2329.2	169.2
Procurement cost	$460.0	$2,784.3	505.3
Total program cost	$1,325.2	$5,113.4	285.9
Program unit cost	$331.296	$730.489	120.5
Total quantities	4	7	75.0
Acquisition cycle time (months)	41	98	139.0

Baseline estimates above are for seaframe-related costs only. Research and development funding includes detail design and construction of two ships.

Seventeen of 19 critical technologies for the LCS seaframes are mature and have been demonstrated in a realistic environment. For LCS 2, the trimaran hull and aluminum structure are both nearing maturity. The Navy could not provide data on design completion for either LCS 1 or LCS 2. The Navy identified watercraft launch and recovery as a major risk for both designs. Acceptance trials for LCS 1 showed it may not meet stability requirements if critically damaged. To increase LCS 1 buoyancy, the Navy added internal and external tanks. Challenges for LCS 2 include completing required endurance testing of the main propulsion diesel engines and addressing pitting and corrosion in the waterjets. The Navy modified its acquisition strategy for future seaframes. After selecting one design, the Navy plans to award contracts for the next 10 ships in fiscal year 2010.



LCS Program

Technology Maturity

Seventeen of 19 critical technologies for both LCS designs are mature. For LCS 2, the trimaran hull and aluminum structure are nearing maturity. The Navy identified watercraft launch and recovery—essential to complete the LCS antisubmarine warfare and mine countermeasures missions—as a major risk to both seaframe designs. Watercraft launch and recovery systems have not been fully demonstrated for either seaframe. On the LCS 1, the Navy is conducting dynamic load testing, but integration with the Remote Multi-Mission Vehicle—a physically stressing system to launch and recover—is not scheduled to occur until after the ship's shakedown cruise. For LCS 2, factory testing of the twin boom extensible crane revealed performance and reliability concerns that were not fully addressed prior to installation. In addition, program officials report the LCS 2 main propulsion diesel engines have not completed a required endurance test, in part due to corrosion in each engine's intake valves. As an interim solution, the Navy has installed new intake valves, which enabled the ship to complete acceptance trials. LCS 2 has also experienced pitting and corrosion in its waterjet tunnels. The Navy has temporarily fixed the issue and plans to make weld repairs to pitted areas during a future dry dock availability.

Design and Production Maturity

The Navy could not provide data on completion of basic and functional drawings—a metric of design stability—at the start of LCS 1 and LCS 2 construction. The Navy used a concurrent design-build strategy for the two seaframes, which proved unsuccessful. Implementation of new design guidelines, delays in major equipment deliveries, and strong focus on achieving schedule and performance goals resulted in increased construction costs. LCS 1 and LCS 2 still require design changes as a result of maturing key systems. At the same time, shipbuilders are constructing modules for the next two ships, LCS 3 and LCS 4. At fabrication start for each ship, approximately 69 percent (LCS 3) and 57 percent (LCS 4) of basic and functional drawings were complete. Starting construction before drawings are complete could result in costly out-of-sequence work and rework to incorporate new design attributes. Incomplete designs at construction also led to weight increases for LCS 1 and LCS 2. According to the Navy, this weight growth contributed to a higher than desired center of gravity on LCS 1 that degraded the stability of that seaframe. Acceptance trials showed LCS 1 may not meet Navy stability requirements in a damaged condition. In response, the Navy added internal and external buoyancy tanks. For LCS 3, the contractor has incorporated a design change to extend the transom by four meters to improve stability.

Other Program Issues

In an effort to improve affordability in the LCS program, the Navy modified its acquisition strategy for future seaframes. The new strategy calls for selecting one seaframe design and awarding one prime contractor and shipyard a fixed-price incentive contract for construction of up to 10 ships between fiscal year 2010 and fiscal year 2014. Navy officials report that the earned value management systems (EVMS) in each of the LCS shipyards do not yet meet Defense Contract Management Agency requirements. Under the terms of the LCS 3 and LCS 4 contracts, the shipyards must achieve EVMS certification within 28 months from the date of the award. Until those requirements are met, cost and schedule data reported by the prime contractors cannot be considered fully reliable.

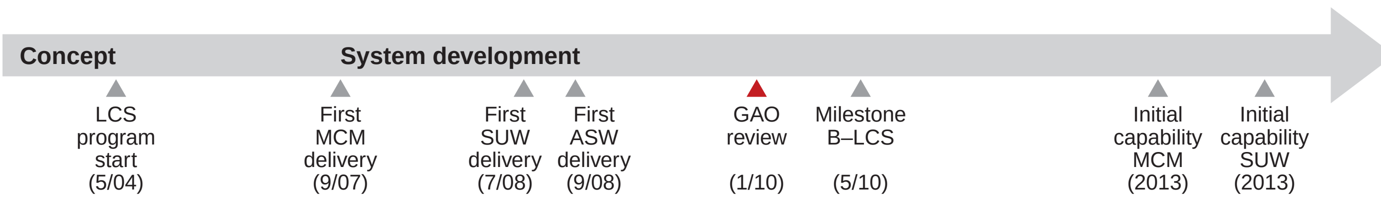
Program Office Comments

According to the Navy, the LCS program continues to deliver vital capability with the recent commissioning of LCS 2. The Navy stated that LCS 1 now meets the damage stability requirement with the addition of external tanks on the rear of the ship. The shipbuilder incorporated additional stability improvements to the design for LCS 3. In the continuing effort to ensure the delivery of affordable LCS capability, the Navy said it revised the acquisition strategy in 2009 to down select to a single design in fiscal year 2010 and procure up to 10 ships in a block buy. The winner of this competition will also be responsible for developing a technical data package to support competition for a second shipbuilder to build up to 5 ships in fiscal year 2012-2014. Construction continues on LCS 3 and LCS 4. To address corrosion of the waterjet tunnels, the Navy stated that electrical isolation of propulsion shafts from the waterjets is being incorporated and a plan is in place to renew the corroded metal in the waterjet intake tunnels.

Littoral Combat Ship-Mission Modules

The Navy's Littoral Combat Ship (LCS) will perform mine countermeasures, surface warfare, and antisubmarine warfare missions using modular mission packages. Packages include weapons and sensors that operate from MH-60 helicopters or unmanned underwater, aerial, or surface vehicles. Initial packages are partially capable. They include engineering development models and some, but not all, systems planned. Mission capability improves with each package delivered until it reaches a baseline capability of production-representative systems.

Source: © Northrop Grumman Corporation.



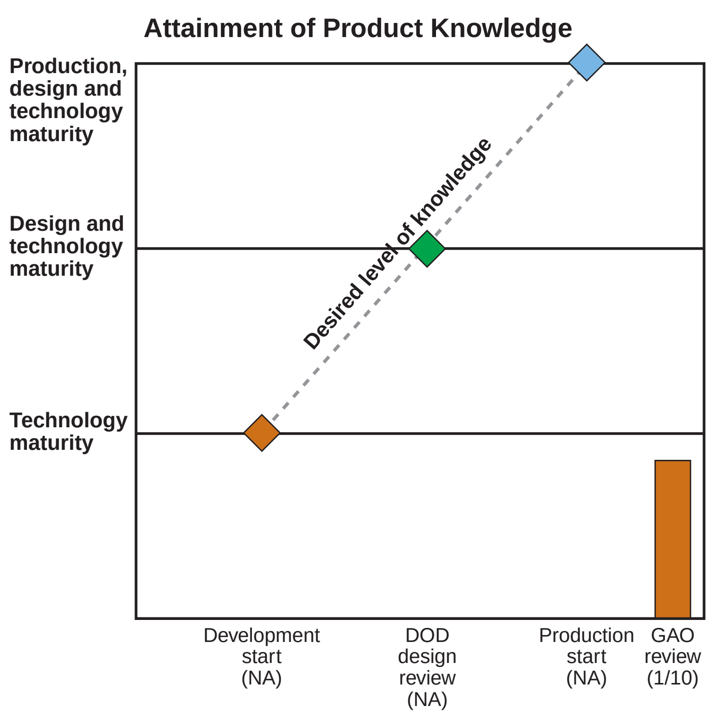
Program Essentials

Prime contractor: Northrop Grumman Corporation, Integrated Systems
Program office: Washington, DC
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 08/2007	Latest 10/2009	Percent change
Research and development cost	$479.7	NA	NA
Procurement cost	$3179.1	NA	NA
Total program cost	$3,658.8	NA	NA
Program unit cost	$57.169	NA	NA
Total quantities	64	NA	NA
Acquisition cycle time (months)	NA	NA	NA

The Navy has accepted delivery of partially capable Mine Countermeasures (MCM), Surface Warfare (SUW), and Antisubmarine Warfare (ASW) mission packages. Overall, operation of the MCM, SUW, and ASW packages requires a total of 22 critical technologies, including 11 sensors, 6 vehicles, and 5 weapons. Most of these technologies are mature; however, some mission systems have experienced test failures and have not demonstrated the ability to meet requirements or provide the capability needed. Individual mission systems in the MCM and ASW packages do not meet reliability requirements and the ASW package as configured does not provide sufficient capability to meet the range of threats. The mission package acquisition and testing strategies are also in flux due to changes in the LCS program.



LCS Modules Program

Technology Maturity

Operation of the MCM, SUW, and ASW packages on the LCS requires a total of 22 critical technologies, including 11 sensors, 6 vehicles, and 5 weapons. Of these technologies, 16 are mature and have been demonstrated in a realistic environment. In the past year, the Navy removed three critical technologies from LCS mission modules due to changes in future ASW packages.

The Navy has accepted delivery of two partially capable MCM mission packages; however, the program has delayed the procurement of the fiscal year 2009-funded package due to technical issues and the resulting operational test delays. Four MCM systems—the Unmanned Surface Vehicle (USV), Unmanned Sweep System (USS), Organic Airborne and Surface Influence Sweep (OASIS), and Rapid Airborne Mine Clearance System (RAMICS)—have not yet been demonstrated in a realistic environment, and two others—the Airborne Laser Mine Detection System (ALMDS) and Remote Minehunting System (RMS)—cannot meet system requirements. ALMDS has been unable to meet its mine detection requirements at its maximum depth or its mine detection and classification requirements at surface depths. RMS demonstrated poor system reliability, availability, and maintainability in a September 2008 operational assessment, and program officials report the system is currently undergoing a series of tests to try to improve its reliability. Program officials also reported that the cable used to tow certain airborne MCM systems had to be redesigned following test failures with two systems.

The Navy accepted delivery of one partially capable SUW mission package in July 2008. This package included two engineering development models for the 30 mm gun, but did not include the Non-Line-of-Sight Launch System (NLOS-LS) launcher or missiles. Integration of the gun with LCS 1 was completed in January 2009. The gun module design appears stable with 100 percent of its drawings released to manufacturing. According to program officials, NLOS-LS was tested in August 2009, but was unable to fire due to a malfunctioning sensor and battery connector. The program expects delivery of the second SUW mission package in March 2010. It will include the 30 mm gun module and the NLOS-LS launcher, but no missiles.

The Navy accepted delivery of one partially capable ASW mission package in September 2008, but plans to reconfigure the content of future packages before procuring additional quantities. According to Navy officials, recent warfighting analyses showed that the baseline ASW package did not provide sufficient capability to meet the range of threats. The current package will undergo developmental testing and the results will inform future configuration decisions. The first package underwent end-to-end testing in April 2009 and will undergo developmental testing in fiscal year 2010. During the 2009 end-to-end test, the Navy found that the USV and its associated sensors will require reliability and interface improvements to support sustained undersea warfare.

Other Program Issues

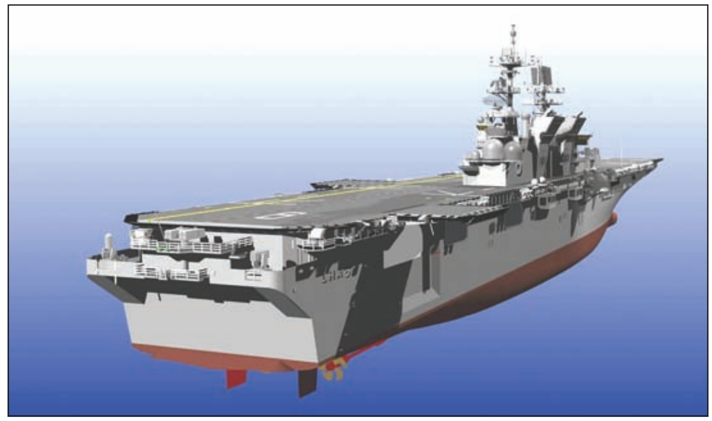
Recent changes to the LCS seaframe acquisition strategy may necessitate changes to the LCS mission module acquisition strategy and testing plans. For example, the new seaframe strategy calls for the program to select a single design in fiscal year 2010. According to program officials, the first mission modules will still be tested on both seaframe designs, but future mission modules could be tested on one or both seaframe designs.

Program Office Comments

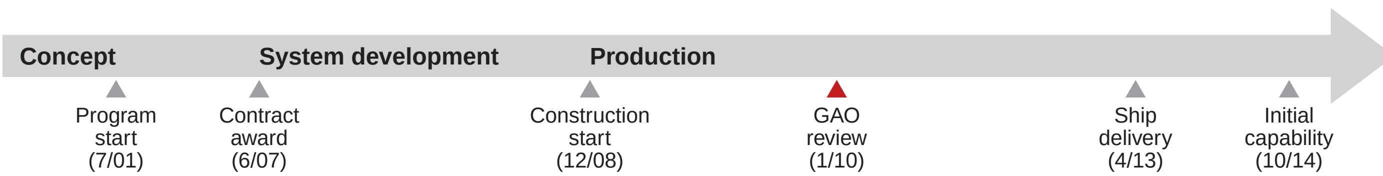
The Navy stated that early packages will be delivered with partial capability, with systems added to the packages as they reach the level of maturity necessary for fielding. According to the Navy, the USV, USS, OASIS, and RAMICS have not entered production or been demonstrated in an operational environment. However, ALMDS and RMS have to date achieved a majority of their key performance requirements. The Navy stated these systems will be available in time to support planned retirement of legacy MCM forces. According to the Navy, it has initiated a program to address RMS reliability. The Navy noted that the program recently declared a critical Nunn-McCurdy cost breach and is under review by the Under Secretary of Defense (Acquisition, Technology & Logistics). Further, the Navy stated it has resolved technical issues related to the helicopter tow cable and the associated systems are ready to resume testing, while mission package acquisition and testing strategies have been updated to reflect seaframe acquisition strategy changes.

LHA 6 Amphibious Assault Ship Replacement Program

The Navy's LHA 6 will replace the aging LHA 1 Tarawa-class amphibious assault ships. The LHA 6 is a modified variant of the LHD 8 amphibious assault ship, which was commissioned in October 2009. The LHA 6 features enhanced aviation capabilities and is designed to support all Marine aviation assets in the Expeditionary Strike Group, including the V-22 Osprey and the F-35B Joint Strike Fighter. Construction of the LHA 6 began in December 2008 with delivery scheduled for April 2013.



Source: LHA-6 Program Office.



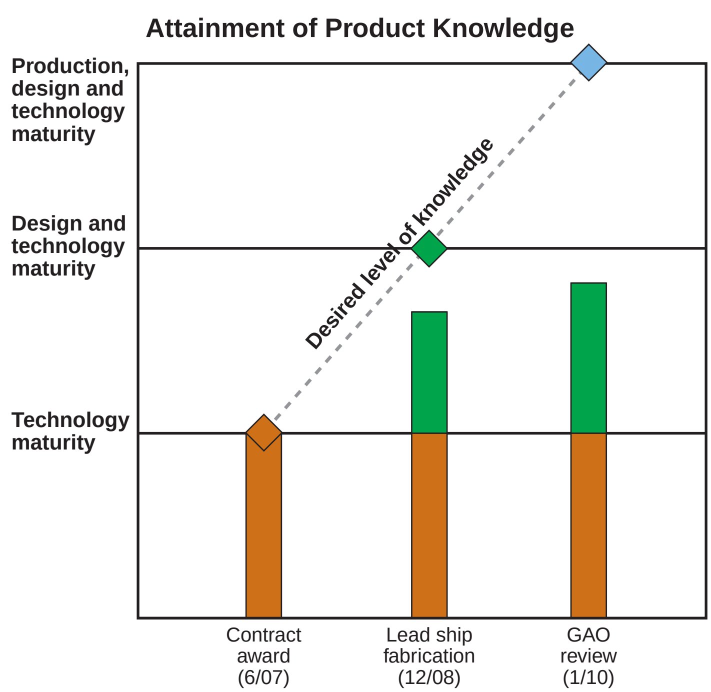
Program Essentials

Prime contractor: Northrop Grumman Ship Systems
Program office: Washington, D.C.
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of 01/2006	Latest 08/2009	Percent change
Research and development cost	$215.5	TBD	NA
Procurement cost	$2,886.5	TBD	NA
Total program cost	$3,102.0	TBD	NA
Program unit cost	$3,101.960	TBD	NA
Total quantities	1	1	0.0
Acquisition cycle time (months)	146	159	8.9

The LHA 6 began construction in December 2008 with mature technologies, but an incomplete design. The LHA 6 began construction with 65 percent of its design complete. By November 2009, almost 95 percent of detailed design drawings had been released. The Navy conducted two production readiness reviews to assess the shipbuilder's readiness to commence full construction. In addition, as of September 2009, the program office had conducted unit readiness reviews for 141 of the ship's 216 assembly units. The LHA 6 is likely to experience further cost growth because postdelivery rework of the ship's deck may be necessary to cope with the intense, hot downwash of the Joint Strike Fighter.



LHA 6 Program

Technology Maturity

In 2005, DOD and the Navy concluded that all LHA 6 components and technologies were mature and will have been installed on other ships prior to LHA 6 delivery. Although not considered critical technologies, the program has identified six key subsystems needed to achieve the LHA 6's full capabilities. Five of these are mature, installed on numerous Navy ships, and do not require modification for installation on the LHA 6. The sixth, the Joint Precision Approach and Landing System (JPALS), a Global Positioning System-based aircraft landing system, is still in development. JPALS is not required to achieve the LHA 6's operating requirements nor is construction dependent on its availability. In addition, the program office has identified the machinery control system as a subsystem that may pose some risk. However, the LHA 6 control system will be largely based on the LHD 8 system, using 99 percent of the LHD 8 software code, and is expected to be less complex with fewer signals than the LHD 8 system.

Design Stability

The LHA 6 began construction in December 2008 with only 65 percent of its design complete. As of November 2009, almost 95 percent of the ship's detailed design drawings had been released. Approximately 45 percent of the LHA 6 design is based on the LHD 8. Changes from the LHD 8 to the LHA 6 include the expansion of the aviation hangar and removal of the well deck to accommodate more aircraft and create additional aviation fuel capacity.

Production Maturity

The Secretary of the Navy certified that the LHA 6 program was ready to commence full shipbuilding construction activities in a report to Congress in July 2009. The Navy conducted two production readiness reviews to assess the shipbuilder's ability to commence and sustain production of the ship. In addition, as of September 2009, the program office had conducted unit-level readiness reviews for 141 of the ship's 216 assembly units. According to the program office, these unit-level reviews are conducted prior to beginning production of each unit to ensure shipbuilder readiness and uninterrupted production. The Navy also requires the shipbuilder to track and report on various production metrics throughout construction.

Other Program Issues

The LHA 6 is likely to experience further cost growth. Costly postdelivery rework of the ship's deck may be necessary to cope with the intense, hot downwash of the Joint Strike Fighter aircraft. The heat from these aircraft could warp the LHA 6 deck or damage deck equipment. The Navy is planning to conduct aircraft tests on the LHD 1 during the fall of 2010, and will then determine whether the LHA 6 and other Joint Strike Fighter-capable ships need to modify their flight decks. The program office does not expect the Navy to finalize a solution for the LHA 6 prior to ship delivery, which could lead to expensive rework on the new ship if the deck surface has to be modified.

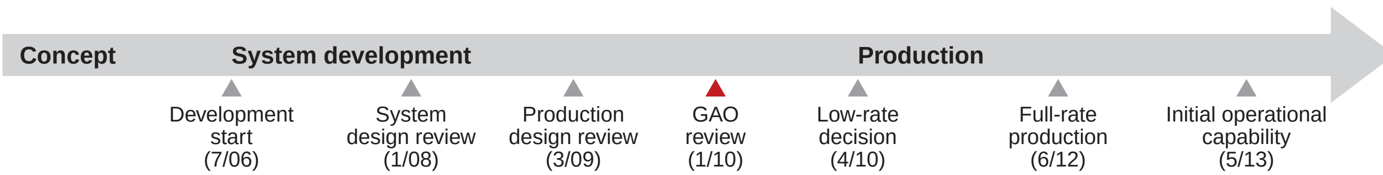
Program Office Comments

In commenting on a draft of this assessment, the Navy stated that the LHA 6 has been designed from the outset to better integrate the Joint Strike Fighter. The Navy noted that improvements over other amphibious assault ships include a larger hangar, shops, and aviation parts stowage to better accommodate maintenance requirements and an increased aviation ordnance and fuel capacity to support the higher sortie rate of the Joint Strike Fighter. The Navy also provided technical comments, which were incorporated as appropriate.

Longbow Apache Block III

The Army is inserting Block III enhancements into the AH-64D Longbow Apache helicopter to modernize its capability to simultaneously conduct missions across the warfare spectrum. Apache Block III (AB3) upgrades are expected to amplify performance, improve situational awareness, enhance lethality, increase survivability, provide interoperability, and help prevent friendly fire incidents. Upgraded AH-64D Longbow Apache helicopters are scheduled to enter service starting in 2011.

Source: Army ATTC Office, Fort Rucker; Apache PMO.



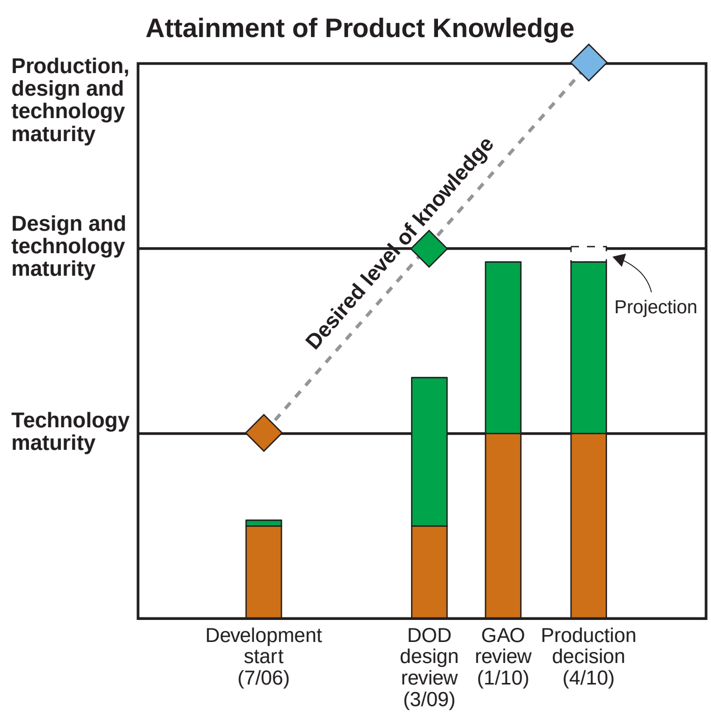
Program Essentials

Prime contractor: Boeing
Program office: Huntsville, AL
Funding needed to complete:
- R&D: $487.3 million
- Procurement: $8,497.5 million
- Total funding: $8,984.9 million
- Procurement quantity: 634

Program Performance (fiscal year 2010 dollars in millions)

	As of 08/2006	Latest 02/2009	Percent change
Research and development cost	$1,127.1	$1,112.9	-1.3
Procurement cost	$5,937.3	$6,844.0	15.3
Total program cost	$7,064.3	$7,956.9	12.6
Program unit cost	$11.735	$12.452	6.1
Total quantities	602	639	6.1
Acquisition cycle time (months)	79	79	0.0

According to the program office, AB3 critical technologies will be mature and its design will be stable by its April 2010 production decision. The program entered system development in July 2006 with its one critical technology—an improved drive system—nearing maturity. A developmental test aircraft successfully completed its first flight in July 2008 and, according to the program office, recent flight tests demonstrated the maturity of the drive system in a realistic environment. The program plans to hold a series of design reviews that correspond to the three time-phased insertions of the program. According to the program office, over 85 percent of the design drawings for the first time-phased insertion were releasable at the March 2009 review. We did not assess production maturity because the program has not started collecting production data.



AB3 Program

Technology Maturity

The AB3 program entered system development in July 2006 with one critical technology—an improved drive system—nearing maturity. This is the first time this technology will be used in a helicopter transmission, and it is expected to provide more available power and reliability than the existing transmission. According to program officials, the maturity of the improved drive system was demonstrated in a realistic environment during recent flight tests.

The AB3 upgrade and modernization effort involves a time-phased series of technical insertions. There are three phases. First, each Apache aircraft will go to the factory for Block III modifications to complete most of the required hardware changes. The remaining two phases of modifications consist of software improvements that can be installed in the field, which eliminates the need to return the aircraft to the factory, reduces the time an aircraft is away from the unit, and increases the training time for soldiers in the field.

Design Maturity

According to the program office, the AB3 design for the first time-phased insertion is stable. Overall, the AB3 program plans to hold four critical design reviews, including one before the start of each time-phased insertion. The success of each review determines whether the program will move forward. According to program officials, a provision in the AB3 contract requires the contractor to complete 85-90 percent of the estimated design drawings for the design review that corresponds to the time-phased insertion.The contractor met this goal for the January 2008 system-level design review and the March 2009 design review that supports the program's production decision. The last two design reviews, which involve software insertions, should not significantly affect the total number of design drawings and are slated for fiscal years 2012 and 2014.

Production Maturity

The low-rate production decision for the AB3 program is currently scheduled for April 2010. We did not assess production maturity because the program has not started collecting production data. According to the AB3 program, it plans to use engineering manufacturing readiness levels, a metric that takes into account technology and design maturity, as well as manufacturing readiness, to assess its production maturity.

Other Program Issues

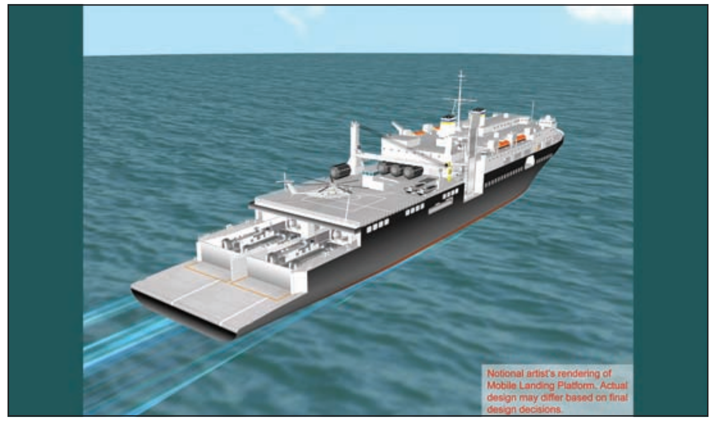
In 2008, as part of DOD's new configuration steering board process, the AB3 program requested a number of changes that, if approved, could yield cost and schedule savings. First, due to concerns with armor on the Block I and II Apaches, the AB3 program will redesign and requalify the armor for Block III. Second, the program proposed focusing testing on new components and requested a waiver from full-up system level live fire testing from the Director of Operational Test and Evaluation. DOD has approved this request and the alternative live-fire strategy has been developed. Third, the program requested to initially test aircraft survivability equipment on the Block II aircraft in order to help prevent schedule delays and reduce risk. DOD officials approved this request, but directed that testing on an AB3 aircraft be completed prior to the full-rate production decision. Fourth, due to initial delays on the Joint Tactical Radio System, the AB3 program began using a Link-16 emulator to meet Phase II developmental test requirements and proposed moving full integration from Phase II to Phase III. However, the Joint Tactical Radio System development has proceeded on schedule allowing the Link-16 capability to be integrated into Phase II and the full Joint Tactical Radio System capability (Solider Radio Waveform, Wide Network Waveform) in Phase III.

Program Office Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated where appropriate.

Maritime Prepositioning Force (Future) / Mobile Landing Platform

The Navy's Mobile Landing Platform (MLP) is one of six classes of ships under consideration for the planned Maritime Prepositioning Force (Future)—MPF(F)—squadron that supports seabasing. The MLP would facilitate at-sea vehicle and cargo transfer, support the employment of combat-ready forces from over the horizon, and serve as a staging area for supplies that support activities on shore. The Navy plans to procure a total of three MLP ships. The MLP—a new ship design for the Navy—is currently in the technology development phase.



Source: Computer Science Corp.

Concept | System development | Production

- Program start (6/08)
- GAO review (1/10)
- Design/construction approval (12/10)
- Lead ship fabrication start (1/13)
- Lead ship delivery (3/16)

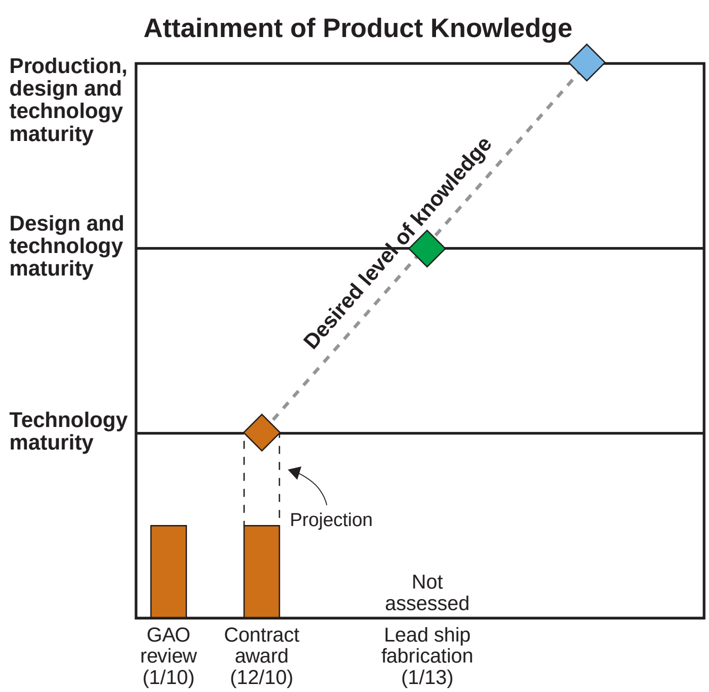
Program Essentials

Prime contractor: General Dynamics/NASSCO
Program office: Washington, DC
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: 3

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2004	Latest 08/2009	Percent change
Research and development cost	NA	$91.6	NA
Procurement cost	NA	$3,446.5	NA
Total program cost	NA	$3,538.2	NA
Program unit cost	NA	$1,179.384	NA
Total quantities	NA	3	NA
Acquisition cycle time (months)	NA	171	NA

The MLP program plans to have its five critical technologies mature and demonstrated in a realistic environment before awarding a detail design and construction contract for the first ship in 2011. Of these five technologies, the skin-to-skin mooring and craft interface are currently mature and the crane is nearing maturity. The program plans to bring the remaining technologies, the vehicle transfer system and dynamic positioning system, to full maturity in January 2010 through at-sea testing with full-scale test articles and an MLP surrogate ship. The program's fiscal year 2010 budget request delayed full funding of the program, shifting the milestone review to authorize a production contract from fiscal year 2010 to 2011. According to program officials, the MPF(F) squadron concept is currently under review. The results of this review could affect the future of the MLP program.



MPF F MLP Program

Technology Maturity

The MLP program has identified five technologies as critical to the functionality of the ship and plans to demonstrate their maturity in a realistic at-sea environment before DOD authorizes detail design and construction in 2010. Of the five technologies identified, the most mature are the skin-to-skin mooring and craft interface technologies, which allow connections between other surface ships for loading and unloading cargo. These technologies have been tested at sea through the use of surrogate platforms. According to the program office, the pendulation control system crane, which allows the transfer of 20-foot shipping containers in varying weather conditions, is nearing maturity and will demonstrate full maturity through demonstrations in a realistic environment in early fiscal year 2010. The vehicle transfer system and dynamic positioning system, the final two technologies for the MLP, are currently immature. The vehicle transfer system is a large ramp that allows equipment and personnel to be transferred from heavy lift ships to the MLP at sea before being loaded into landing craft for transfer to shore. The primary challenge for this technology is transferring cargo in different weather conditions while both ships are in motion. Together with the dynamic positioning system, which aligns the MLP with other ships using position sensors and the propulsion system, the vehicle transfer system will be tested in a realistic environment in January 2010. For this test the program office intends to outfit a surrogate MLP with full-scale test articles of both the vehicle transfer and dynamic positioning systems and test the ability to transfer cargo between ships in varying weather conditions.

Design Maturity

The design of the MLP is being developed by General Dynamics NASSCO and, according to program officials, is in the preliminary stages with many of the key decisions, such as the arrangement of the propulsion systems, yet to be finalized. While the Navy and General Dynamics NASSCO do plan to develop the design utilizing a three-dimensional model, according to program officials work on the model will only begin after a detail design and construction contract is awarded.

Other Program Issues

DOD has delayed requesting full funding for the first ship until fiscal year 2011 with the intent of allowing more time for the program to develop its design. As a result, the milestone review for authorizing detail design and construction was rescheduled from the third quarter of fiscal year 2010 to the first quarter of fiscal year 2011. However, DOD requested and Congress authorized $120 million in fiscal year 2010 funding for long-lead materials. According to program officials, a review of the MPF(F) concept is currently underway. The results of this review could result in further changes to the MLP program.

Program Office Comments

Based on the Quadrennial Defense Review and the 30-year shipbuilding plan, a lower-cost variant of the MLP is being designed. It is based on an Alaska-class crude oil carrier modified to be a float-on/float-off vessel. Using the parent design offers the Navy an opportunity to increase design maturity and reduce technological risk. These ships will provide concept validation, operational testing, and an incremental operational capability. The current test article for the vehicle transfer system is providing positive results that will inform the future design.

MQ-9 Reaper Unmanned Aircraft System

The Air Force's MQ-9 Reaper (formerly Predator B) is a multirole, medium to high-altitude endurance unmanned aerial vehicle system capable of flying at higher speeds and higher altitudes than its predecessor, the MQ-1 Predator A. The Reaper is designed to provide a ground attack capability to find, fix, track, target, engage, and assess small ground mobile or fixed targets. Each system consists of four aircraft, a ground control station, and a satellite communications suite. We assessed Increment 1.

Taken in performance of official duties as a photographer/journalist. (U.S. Air Force Photo/Master Sgt. Robert W. Valenca)
Source: http://www.af.mil/shared/media/photodb/photos/071110-F-1789V-991.jpg.

Concept | System development | Production | Initial capability

- Program start (1/02)
- Development start (2/04)
- Low-rate decision (2/08)
- GAO review (1/10)
- Initial capability (TBD)
- Full-rate decision (3/13)
- Last procurement (2017)

Program Essentials

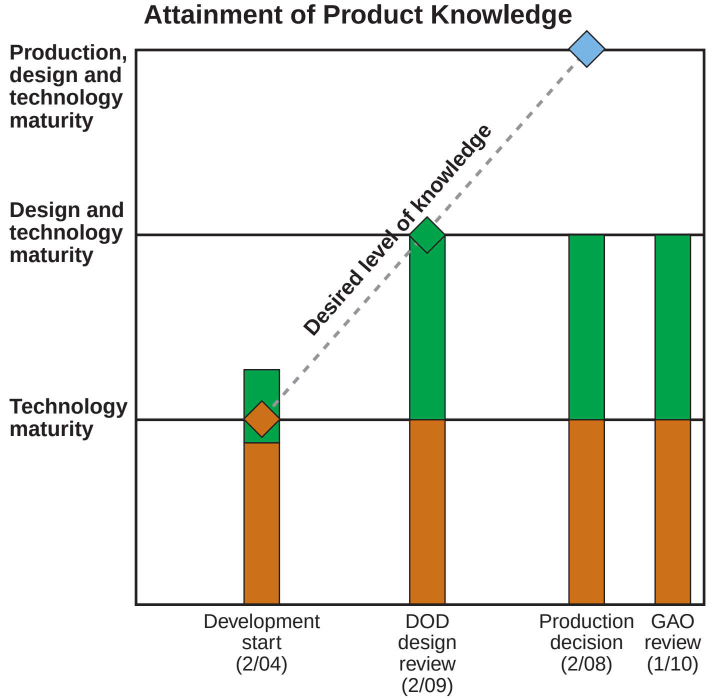
Prime contractor: General Atomics Aeronautical Systems Incorporated
Program office: Wright-Patterson AFB, OH
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 02/2008	Latest 12/2009	Percent change
Research and development cost	$409.7	$599.0	46.2
Procurement cost	$2,059.6	$8,525.0	313.9
Total program cost	$2,572.2	$9,124.0	254.7
Program unit cost	$24.498	$35.780	46.1
Total quantities	105	255	142.9
Acquisition cycle time (months)	NA	NA	NA

In the past year, the Reaper program has been designated a major defense acquisition program. All four of its original critical technologies are mature, but there are numerous technology improvements planned for the system. The program office has begun a block upgrade that includes system power increases and improvements to the primary data link. Planned aircraft quantities have more than doubled since fiscal year 2007 and the total is expected to increase again in the fiscal year 2011 budget due to user demands and the decision to terminate Predator procurement. Initial operational testing was completed in August 2008. The Reaper was effective in the killer role, but issues associated with the radar and network precluded the test team from evaluating the other two key performance parameters, the hunter and the net-ready capability.

Attainment of Product Knowledge



MQ-9 Reaper Program

Technology Maturity

The Reaper's four original critical technologies—the synthetic aperture radar, the multispectral targeting system, the air vehicle, and the stores management subsystem—are mature. However, the Air Force has identified numerous technology enhancements that are expected to improve the capability of existing on-board subsystems and ground control stations. These enhancements include upgrades to the synthetic aperture radar, a more secure data link, heavyweight landing gear, an automatic takeoff and landing capability, and a modernized ground control station display. While the program office judged these improvements to be technologically mature, they still must be integrated and tested on the MQ-9 system.

Design Maturity

According to the program office, the MQ-9 design is stable. Because the user required an early operational capability, the Air Force did not conduct a traditional system critical design review. Instead, it conducted a series of smaller incremental reviews of the early operational aircraft configurations. Program officials are also beginning a block upgrade that includes a more secure data link, improved cockpit controls/displays, and increased system power. Some subsystem upgrades will require significant engineering changes. To assess all system changes, the program office plans to conduct a preliminary design review and a critical design review in 2010 to evaluate the block upgrade design maturity. Development testing of the block upgrade is scheduled to be completed in July 2012.

Production Maturity

We did not assess production maturity because the MQ-9 program does not use statistical process controls. The program uses other quality control measures such as scrap, rework, and repair to track product quality. The Air Force has contracted for 77 aircraft, 30 percent of the currently planned total. Although the contractor has had problems in the past with late aircraft deliveries, its recent facilities expansion is now complete, enabling it to increase production from 2.5 to 5 aircraft per month.

Other Program Issues

Since inception, the program—designated an urgent operational need—has followed a nontraditional acquisition path of concurrent development and production. Since fiscal year 2007, total aircraft quantities have more than doubled, largely due to significant increases in the wartime supplemental budgets and the Air Force's decision to curtail future procurement of the Predator in favor of the Reaper. Program officials noted that quantities may continue to grow because of user needs. The system's performance requirements have also continued to change. The program recently began a block upgrade with numerous performance enhancements and has received numerous urgent operational requirements from the warfighter, such as data link encryption, wide area/high resolution surveillance, and a capability to detect dismounted soldiers.

The Reaper completed initial operational testing in August 2008. It was effective in the killer role, but problems associated with radar and the network prevented testers from evaluating the hunter and net-ready capability. To enable testers to fully evaluate the hunter capability, the Air Force is upgrading the radar's ground moving target indicator and target recognition/classification capability, and integrating the radar into the crew station. Follow-on testing is planned for early 2012.

In 2009, the Reaper program was designated a major defense acquisition program. The Air Force plans to begin development of Increment 2 of the MQ-9 Reaper under this program in fiscal year 2013. This increment will include the Small Diameter Bomb, automatic takeoff and land capability, and a de-icing system, along with national airspace certification.

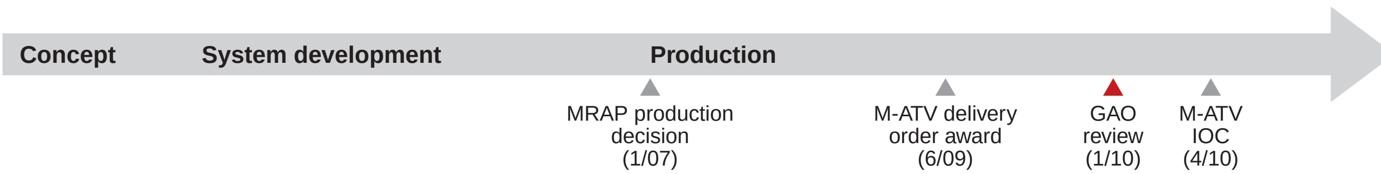
Program Office Comments

In commenting on a draft of this assessment, the Air Force provided technical comments which were incorporated as appropriate.

Mine Resistant Ambush Protected (MRAP) Vehicle

MRAP is a joint program led by the Navy and Marine Corps to procure armored vehicles to protect personnel from mine blasts and fragmentary and direct-fire weapons. DOD acquired and fielded three categories of MRAP for combat and support missions for the Marine Corps, Army, Air Force, Navy, and Special Operations Command. DOD is also acquiring a lighter and more agile version—the MRAP All Terrain Vehicle (M-ATV)—for better off-road mobility but with the current level of protection. We assessed M-ATV and made observations on MRAP.

Source: URS EG&G Division.



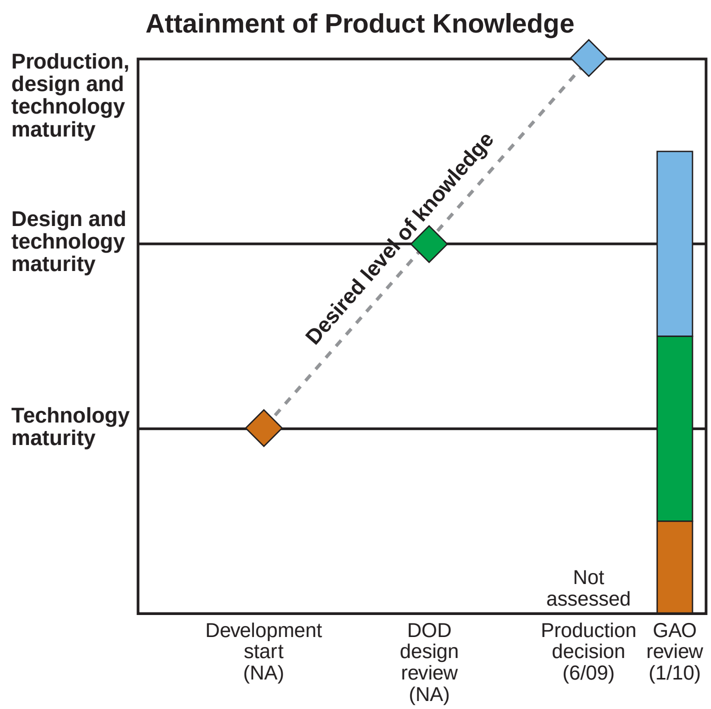
Program Essentials

Prime contractor: Various
Program office: Quantico, VA
Funding needed to complete:
R&D: $189.6 million
Procurement: $8,930.8 million
Total funding: $9,682.2 million
Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2007	Latest 12/2009	Percent change
Research and development cost	$233.6	$609.9	161.1
Procurement cost	$21,359.5	$35,513.1	66.3
Total program cost	$22,566.4	$37,781.6	67.4
Program unit cost	$1.468	$1.651	12.5
Total quantities	15,374	22,882	48.8
Acquisition cycle time (months)	6	6	0.0

To meet an urgent need, DOD is buying the M-ATV as a nondevelopmental item. The technologies for the vehicle are mature, but DOD plans to integrate two new technologies to increase protection. Both technologies are nearing maturity at this time. DOD also considers the design for the vehicle and the production processes to be mature. However, the M-ATV's highly concurrent production and testing schedule creates a risk for costly rework should testing anomalies occur. DOD has yet to make decisions on the role of MRAP and M-ATV in the tactical wheeled vehicle strategy, which will affect the total cost of ownership. For example, DOD has not decided how many of the fleet will remain on active service and how many will be stored or turned over to coalition forces.



MRAP Vehicle Program

Technology and Design Maturity

DOD is buying M-ATV as a nondevelopmental item. Like its MRAP predecessor, the M-ATV vehicles technologies and design are considered mature. The government sought mature systems and offerors were required to submit two production-representative vehicles for inspection within about 6 weeks of submitting a proposal. However, DOD is proposing to integrate two new technologies onto the M-ATV—a Semi-Active Rocket Propelled Grenade Protection System and a Hand-Thrown Threats Defense. According to program officials, prototypes of these technologies are being demonstrated on multiple variants of the MRAP vehicle. Program officials expect both technologies to be mature and demonstrated in a realistic environment by March 2010.

Production Maturity

The production processes for M-ATV appear mature. The manufacturer began delivering vehicles in July 2009, one month after award of the first delivery order for production. As of the end of December, a cumulative 2,544 vehicles—300 more than the 2,244 planned—had been delivered. Program officials believe the contractor will deliver 1,000 vehicles per month and complete deliveries as scheduled in fiscal year 2010.

Other Program Issues

In order to rapidly field the M-ATV vehicles, DOD substantially compressed both developmental and operational test and evaluation, resulting in highly concurrent production and testing schedules. This could lead to postproduction and postfielding fixes for the M-ATV if testing identifies any shortcomings, as was the case for the earlier versions of the MRAP vehicle. By the time operational tests were complete in December 2009, more than 2,500 had been delivered, and by the time the developmental automotive tests are scheduled to be complete in May 2010, all 6,644 vehicles will have been delivered.

Upon completion of M-ATV production in fiscal year 2010, all MRAP variants will have been procured and delivered. At that time, the program will fully transition to operations and sustainment phase. The U.S. drawdown from Iraq and refocusing efforts in Afghanistan pose logistical challenges and uncertainty for refurbishing, retrofitting, and upgrading MRAP and M-ATV assets. Based on the urgency to rapidly field MRAP and M-ATV, the up-front sustainment and logistics planning that is normally part of the acquisition process was not conducted. This could negatively affect near-term reliability and maintainability. The normal planning and resource identification process for long-term sustainment has also been hindered. MRAP readiness has remained high in Operation Iraqi Freedom—95 percent—but is lower in Operation Enduring Freedom—92 percent. Program officials attribute this lower rate to the rugged conditions in Afghanistan, which lead to more breakdowns and make it harder to supply deployed units with repair parts.

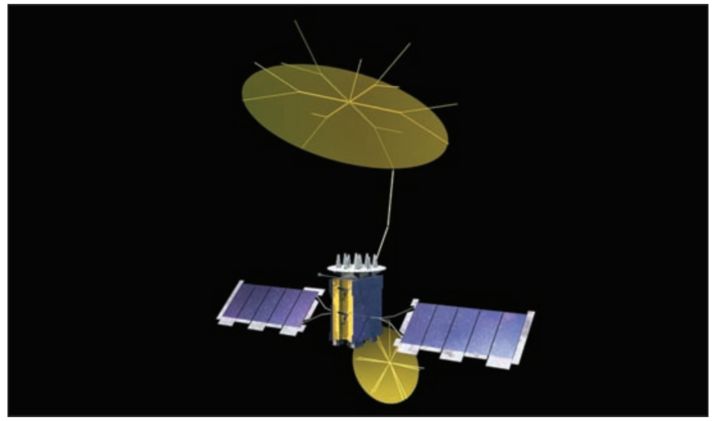
DOD has not yet determined the role of MRAP and M-ATV in the tactical wheeled vehicle strategy, including how many of the fleet will remain on active service and how many will be stored or turned over to coalition forces. These decisions will ultimately affect the total cost of ownership. Other DOD decisions will also affect the future of the program, such as how DOD will integrate the outcome of multiple tactical wheeled vehicle studies into a unified, comprehensive strategy.

Program Office Comments

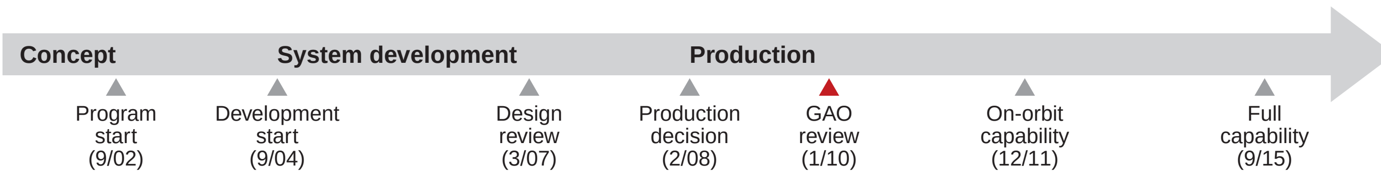
In commenting on a draft of this assessment, program officials stated that the government undertook multiple efforts to mitigate risk associated with the concurrent production and test schedule. The program office conducted source selection testing, which evaluated component and system-level survivability and crew protection of multiple candidate vehicles and consisted of multiple ballistic events against armor samples and vehicles. Automotive performance tests included human factors, mobility, braking, steering, electromagnetic interference, environmental factors, towing and recovery, and Federal Motor Vehicle Safety Standards compliance. Also, soldiers and marines participated in a limited user evaluation that included endurance drives, urban terrain and night operations, and maintenance and logistics inspections.

Mobile User Objective System (MUOS)

The Navy's MUOS, a satellite communication system, is expected to provide a worldwide, multiservice population of mobile and fixed-site terminal users with an increase in narrowband communications capacity and improved availability for small terminals. It is to replace the Ultra High Frequency (UHF) Follow-On (UFO) satellite system currently in operation and provide interoperability with legacy terminals. MUOS consists of a network of satellites and an integrated ground network. We assessed both the space and ground segments.



Source: Lockheed Martin, © 2008 Lockheed Martin.



Program Essentials

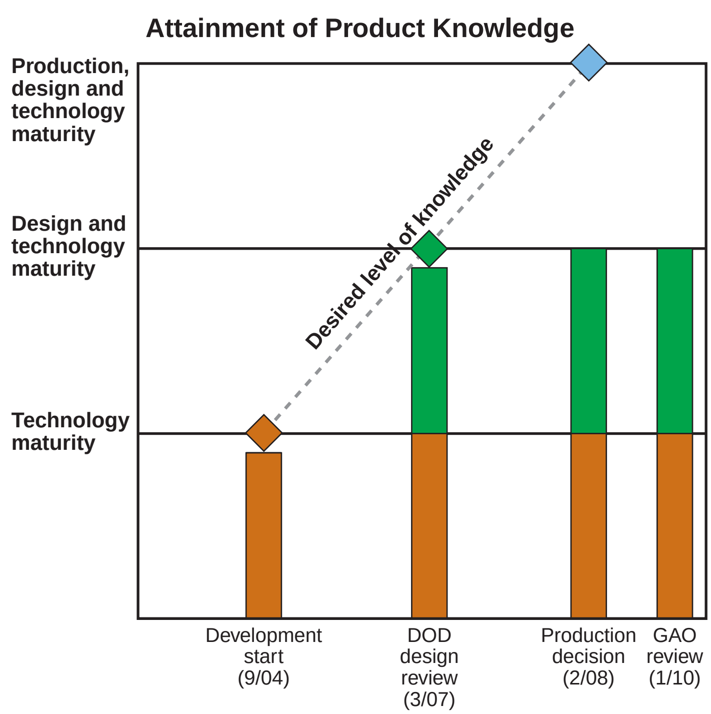
Prime contractor: Lockheed Martin Space Systems
Program office: San Diego, CA
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 09/2004	Latest 01/2010	Percent change
Research and development cost	$3,558.0	NA	NA
Procurement cost	$2,960.5	NA	NA
Total program cost	$6,556.2	NA	NA
Program unit cost	$1,092.697	NA	NA
Total quantities	6	NA	NA
Acquisition cycle time (months)	91	NA	NA

Latest cost data resulting from a late-2009 Defense Acquisition Executive review that established new program cost and schedule baselines were not available at the time of this assessment.

All MUOS critical technologies are mature and all design drawings have been released; however, the discovery of key design flaws late in production, and manufacturing process defects has resulted in cost growth and schedule delays. Additionally, ground segment development challenges have increased program costs. A recent Navy-initiated review of the MUOS program found that while the program is technically sound, its schedule was optimistic and its budget was inadequate. The current estimate for the first satellite to begin on-orbit operations is December 2011, representing an additional 10-month delay from last year's assessment. The delivery of MUOS capabilities is time-critical due to the operational failures of two UFO satellites. The MUOS program has taken several steps to address any potential capability gap prior to on-orbit operations of the first MUOS satellite.



MUOS Program

Technology Maturity

According to the program office, all MUOS critical technologies are mature. The number of critical technologies has varied over time, but all eight current critical technologies have been demonstrated in a realistic environment.

Design and Production Maturity

While the program office has reported that the MUOS design was stable and indicated that the production maturity of the first satellite was high, the program has discovered key design flaws late in production, as well as manufacturing process defects. The design fixes and rework necessary to address issues with the MUOS satellite's diplexed feeds, legacy transmit antenna, and UHF reflectors have resulted in cost increases and schedule delays on the program. The MUOS program does not collect statistical process control data to assess production maturity, but the space segment does collect and track data on manufacturing process defects and analyze defect trends. While manufacturing defects have contributed to cost growth and schedule delays on the program, according to the program office, the number of defects has decreased slightly over time due to the increasing maturity of the manufacturing process.

According to the program office, the program has also experienced software development challenges for the ground segment including poor contractor performance, code growth, greater-than-anticipated number of problem reports, and integration and testing issues. The estimated total lines of software for the ground segment increased about 94 percent from the estimate at development start, and full qualification testing on one of the ground software build increments has been delayed by 1 year. The program manager's estimated cost at completion for the ground software development increased about 51 percent over the past year from about $251 million to about $378 million. According to program officials, software development delays have not yet affected major program milestones.

Other Program Issues

The importance of the first MUOS launch increased due to the unexpected failures of two UFO satellites. Based on the current health of on-orbit satellites, UHF communication capabilities are predicted to fall below the required availability level in January 2011, and remain so until the first MUOS satellite is operational. However, because of MUOS satellite development issues, the current estimate for on-orbit operation of the first satellite is now December 2011—21 months later than initially planned. The MUOS program office is addressing a potential capability gap by activating dual digital receiver unit operations on a UFO satellite, leasing commercial UHF satellite communications services, and examining the feasibility of expanded digital receiver unit operations on the legacy payloads of the MUOS satellites.

In 2009, the Assistant Secretary of the Navy for Research, Development, and Acquisitions initiated a review to assess the technical, schedule, and cost aspects of the MUOS program. The review team found that while the program is technically sound, its schedule was optimistic and its budget was inadequate. Additionally, according to the MUOS program, the Defense Acquisition Executive reviewed the program in late 2009, which authorized the procurement of satellite four and long-lead items needed for satellite five, and established new cost and schedule baselines for the program.

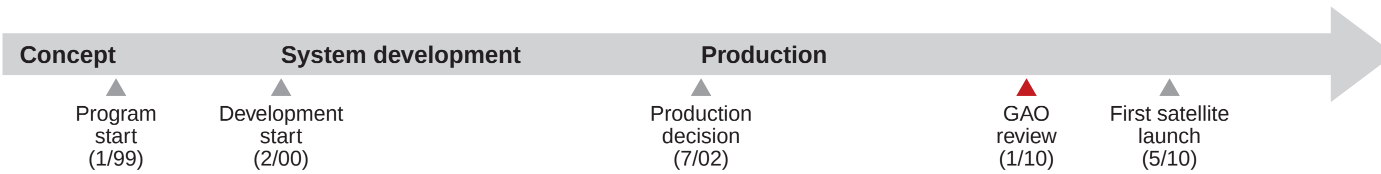
Program Office Comments

In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

Navstar Global Positioning System (GPS) Space & Control

The Air Force's Global Positioning System (GPS) includes satellites, a ground control system, and user equipment. It conveys positioning, navigation, and timing information to users worldwide. In 2000, Congress began funding the modernization of Block IIR and Block IIF satellites. GPS IIF is a new generation of GPS satellites that is intended to deliver all legacy signals plus new capabilities, such as a new civil signal and better accuracy. We assessed the Block IIF.

Source: Boeing.



Program Essentials

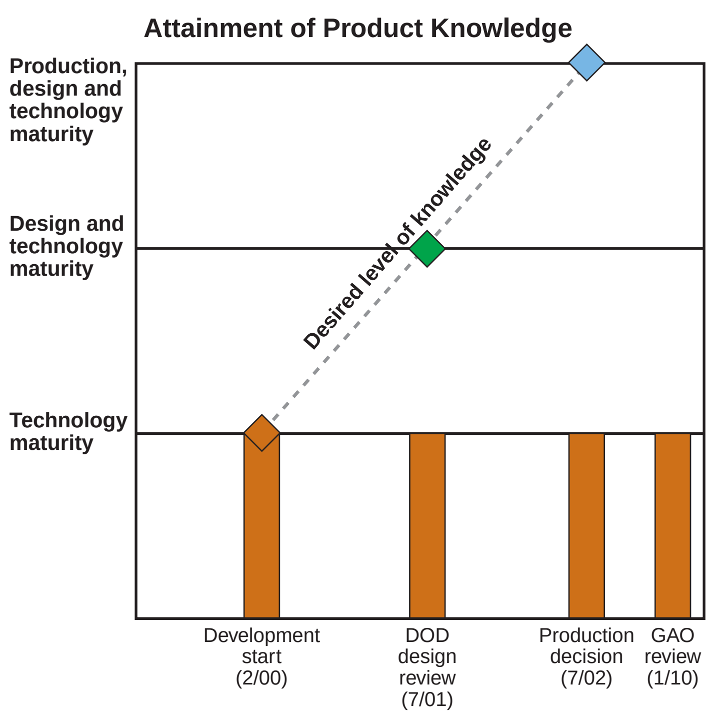
Prime contractor: Boeing for IIF, Boeing for OCS, Lockheed Martin for IIR and IIR-M
Program office: El Segundo, CA
Funding needed to complete:
- R&D: $154.9 million
- Procurement: $239.6 million
- Total funding: $394.5 million
- Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of 07/2002	Latest 09/2009	Percent change
Research and development cost	$2,147.5	$2,636.6	22.8
Procurement cost	$3,916.6	$4,645.5	18.6
Total program cost	$6,064.1	$7,282.1	20.1
Program unit cost	$183.760	$220.669	20.1
Total quantities	33	33	0.0
Acquisition cycle time (months)	NA	NA	NA

Total quantities include 13 IIR, 8 IIR-M, and 12 IIF satellites.

The first GPS IIF satellite launch is scheduled for May 2010, about 3-1/2 years later than originally planned. While development and production problems caused most of the delay, the GPS program attributes the latest delays to launch vehicle and facility availability. Recently identified technical issues could put the May 2010 launch date at risk. By the time the first GPS IIF satellite is tested on orbit, five satellites are scheduled to have completed production. If problems are discovered, these satellites may need to be retrofitted. According to GPS officials, the GPS IIF program has discovered more issues late in development and production than should be expected. Many of these might have been caught earlier with better oversight. We have not been able to assess design stability and production maturity because the necessary data is not collected.



NAVSTAR GPS-Space & Control Program

Technology Maturity

According to the GPS program, the one Block IIF critical technology—space-qualified atomic frequency standards—is mature, meaning it has been demonstrated in a relevant environment.

Design and Production Maturity

We could not assess design stability or production maturity for the GPS Block IIF. According to officials, the Block IIF contract did not require design drawing data to be reported to the program office or for statistical process control data to be collected. According to GPS program officials, they assess design stability and production maturity through practices such as reviews of contractor testing, technical interchange meetings, and periodic program reviews.

Other Program Issues

The first GPS IIF satellite launch is now scheduled for May 2010, about 3 and a half years later than originally planned. GPS officials attributed the latest delays to launch vehicle and facility availability. However, recently identified technical issues could put the May 2010 launch date at risk. GPS officials reported that the GPS IIF program has discovered more issues late in development and production than should be expected.

According to the GPS program, many of these problems might have been identified earlier with sufficient oversight and more rigorous unit qualification efforts. Along with delays, the program has experienced substantial cost growth. The estimated cost to complete the program has more than doubled, from an original estimate of about $729 million to the current estimate of about $1.6 billion.

Even after the first satellite is launched, there are other risks that could affect subsequent launches. For example, by the time on-orbit checkout and testing of the first satellite is complete, at least 5 of the 12 GPS IIF satellites are scheduled to have completed production. If problems are identified during on-orbit testing, the existing satellites may have to be retrofitted to correct these issues. In addition, the GPS IIF program may face further launch challenges because the main launch pad that the GPS IIF will utilize appears to be overscheduled in fiscal years 2011 and 2012.

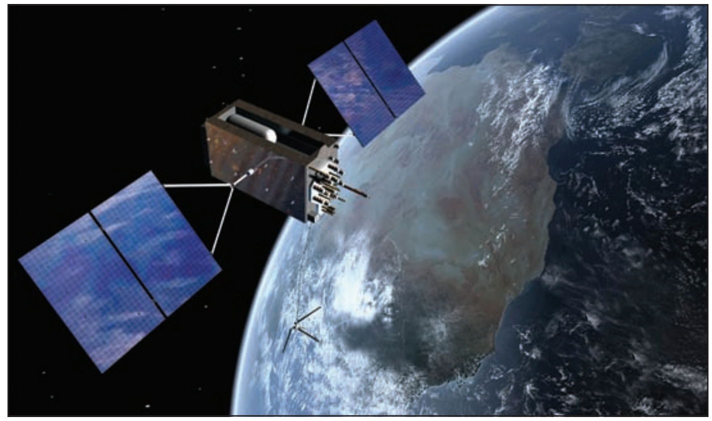
For the overall GPS, some new capabilities are not now available to the warfighter because the ground control system features needed to command and operate the capabilities have not been completely delivered. For example, updated user equipment possessing a capability to prevent spoofing of navigation information started being delivered to the warfighter in 2004. However, the current GPS ground control system is not capable of providing two important aspects of this capability and is not expected to do so until early fiscal year 2010. In addition, GPS will be providing a modernized military signal designed to be secure and jam-resistant. This signal is planned to reach its initial operating capability on the GPS satellites and ground control system by 2014, but the user equipment needed to utilize a the signal is not expected to be fully fielded and operational until 2025.

Program Office Comments

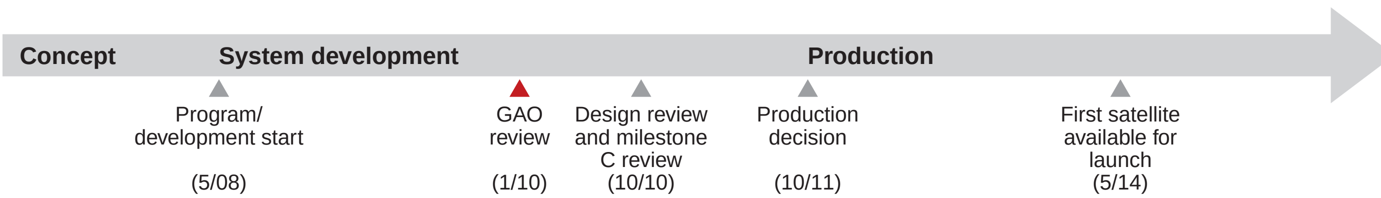
In commenting on a draft of this report, GPS program officials stated that the GPS IIF program made significant strides toward delivery of its first satellite in February 2010 with an anticipated “Available for Launch” in March 2010 and launch in May 2010. In May 2009, GPS IIF Space Vehicle (SV)-2 was used as a Pathfinder vehicle at Cape Canaveral AFS to validate satellite processing procedures and verify end-to-end system performance prior to shipping SV-1 for launch. The Pathfinder mission recovered over 2 months of SV-1 launch schedule and significantly reduced schedule risk associated with first-time launch delivery and processing. While numerous technical challenges have been identified and resolved, the government and contractor teams have maintained mission success as the number-one priority for this nationally-critical program. This focus has created cost and schedule issues for the program, but strong and creative leadership has minimized those effects to the greatest extent possible. Program officials also provided technical comments, which were incorporated as appropriate.

Navstar Global Positioning System (GPS) IIIA

The Air Force's Global Positioning System (GPS) includes satellites, a ground control system, and user equipment. It conveys positioning, navigation, and timing information to users worldwide. GPS III, a future generation of GPS satellites, will provide capabilities in three increments: IIIA, IIIB, and IIIC. We assessed GPS IIIA, which is intended to provide enhanced capabilities, such as a stronger military signal to improve jamming resistance and a new signal for civilian users that will be interoperable with foreign signals.



Source: Lockheed Martin.



Program Essentials

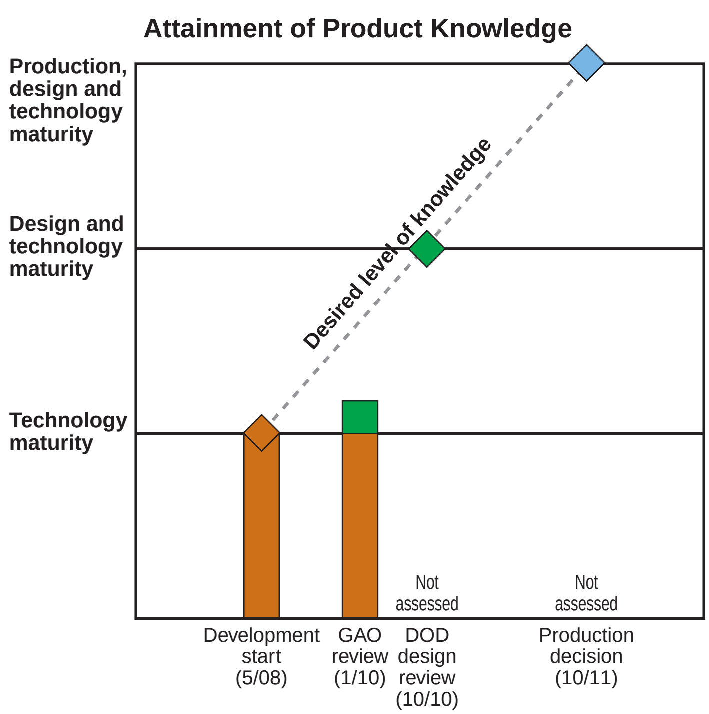
Prime contractor: Lockheed Martin
Program office: El Segundo, CA
Funding needed to complete:
- R&D: $1,401.4 million
- Procurement: $1,300.6 million
- Total funding: $2,702.0 million
- Procurement quantity: 6

Program Performance (fiscal year 2010 dollars in millions)

	As of 05/2008	Latest 09/2009	Percent change
Research and development cost	$2,462.2	$2,380.4	-3.3
Procurement cost	$1,382.4	$1,300.6	-5.9
Total program cost	$3,844.6	$3,680.9	-4.3
Program unit cost	$480.580	$460.117	-4.3
Total quantities	8	8	0.0
Acquisition cycle time (months)	NA	NA	NA

We could not calculate acquisition cycle times for GPS IIIA because initial operational capability will not occur until GPS IIIC satellites are fielded.

In May 2008, the GPS IIIA program began system development and awarded a contract for the development and production of eight satellites. At that time, the program office reported that all five critical technologies were mature. A more recent assessment identified seven critical technologies, which are also mature, according to the GPS program. The program completed preliminary design review in May 2009, and the critical design review is planned for October 2010. Sixteen percent of the program's design drawings are releasable. The Air Force faces a number of challenges in delivering GPS IIIA satellites on schedule. The satellite's development schedule appears compressed; the satellites are being developed and built by a different contractor than the GPS IIF; and the GPS IIIA involves a larger satellite bus and more powerful military signal than its predecessor GPS satellites.



GPS IIIA Program

Technology Maturity

According to GPS program officials, in May 2008, the GPS IIIA program identified five critical technologies based on its preliminary baseline. All five critical technologies were determined mature and the program was approved to begin system development. A more recent technology readiness assessment based on the contractor's specific design identified seven critical technologies—the rubidium atomic clock; 28 percent-efficient solar cells; 50 watt field effect transistor; RTAX family of field programmable gate arrays; real time operating system integration with the satellite's processors; L1, L2, L5 triplexers; and a timekeeping system. According to the program office, these seven technologies are also mature and have been demonstrated in a relevant environment.

Design Maturity

The GPS IIIA program completed its preliminary design review in May 2009. The critical design review is planned for October 2010. According to the program office, 16 percent of its total expected design drawings are releasable. Program officials reported that they are confident that at least 90 percent of design drawings will be released this year for critical design review.

Other Program Issues

To prevent the problems experienced on the GPS IIF program from recurring on the GPS IIIA, the Air Force is implementing an incremental development strategy to meet capability needs; using military standards for satellite quality; and exercising more government oversight over the contractor. In addition, the Under Secretary of Defense for Acquisition, Technology and Logistics has specified that the program manager is not allowed to adjust the GPS IIIA program scope to meet increased or accelerated technical specifications, system requirements, or system performance.

However, the Air Force faces a number of challenges in delivering GPS IIIA satellites on schedule. First, we have previously reported that the program schedule appears highly compressed. The Air Force plans to launch the first GPS IIIA satellite in 2014. This would require the program to go from contract award to first launch 3 1/2 years faster than the GPS IIF. The time between contract award and first launch is also less than most other major space programs we have reviewed. In addition, though the contractor has previous experience with GPS, some of its knowledge base will have to be revitalized since it was not the contractor for the GPS IIF. Finally, the contractor is planning to incorporate a previously developed larger satellite bus and increase the power of the military signal.

The GPS IIIA satellites are to be controlled by a future ground control system called the Next Generation GPS Control Segment or OCX. However, OCX will not be fielded by the first planned GPS IIIA launch in May 2014. The Air Force is pursuing various options to increase the life of GPS satellites currently on orbit and provide command and control for the GPS IIIA satellites during launch and checkout to ensure the GPS constellation's performance is sustained.

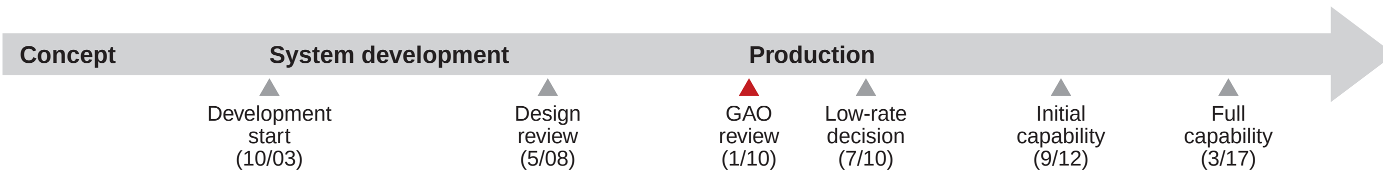
Program Office Comments

In commenting on a draft of this report, GPS program officials stated that they recognize past schedule delays and have purposely structured the GPS III program to mitigate these concerns. The GPS III contractor, Lockheed Martin (LM), has successfully built and flown 37 other A2100 spacecraft bus-based systems. Additionally, LM built the highly successful GPS IIR and IIR-M satellites. LM's major subcontractor, ITT, delivered the complete navigation payload for GPS IIR and IIR-M programs and payload transmitter hardware for GPS IIF. To further enable the achievement of a 72-month schedule, the government invested in a competitive Phase A activity, prototyping numerous critical technologies. Additionally, GPS IIIA is utilizing a "pathfinder" vehicle to identify and resolve integration issues before the assembly of the first flight vehicle. Based on the successful history of LM and ITT, the A2100 bus platform, and the significant risk reduction efforts built into the program, the Air Force has high confidence that the 72-month schedule is an achievable target. Program officials also provided technical comments, which were incorporated as appropriate.

Navy Multiband Terminal (NMT) Program

The Navy's NMT is the next-generation maritime military satellite communications terminal. Together with the Air Force's Advanced Extremely High Frequency satellite system, NMT is designed to enhance protected and survivable satellite communications to naval forces. NMT multiband capabilities will also enable communications over existing military satellite communication systems, such as Milstar, Wideband Global SATCOM, and the Defense Satellite Communications System.

Source: © 2008 Raytheon Company.



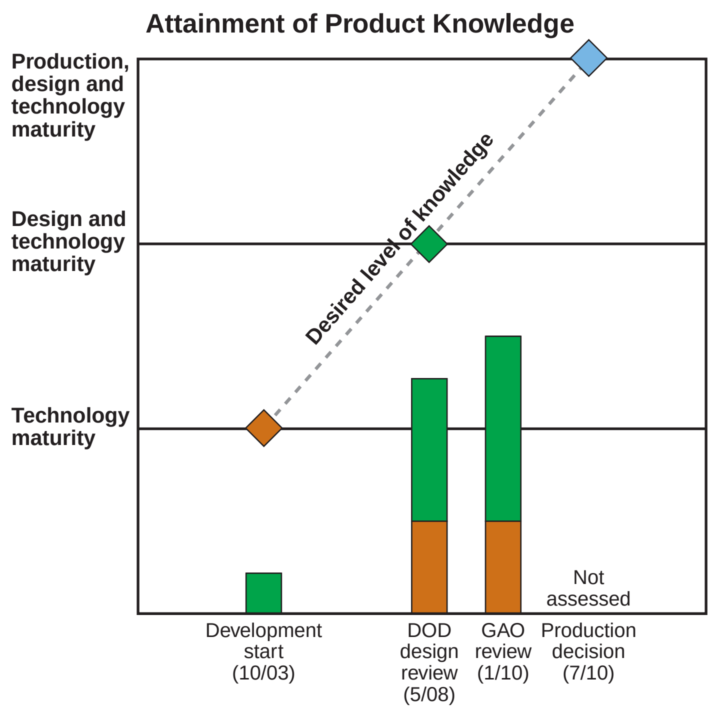
Program Essentials

Prime contractor: Raytheon
Program office: San Diego, CA
Funding needed to complete:
- R&D: $131.6 million
- Procurement: $1,311.1 million
- Total funding: $1,442.7 million
- Procurement quantity: 276

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2006	Latest 08/2009	Percent change
Research and development cost	$680.2	$656.0	-3.5
Procurement cost	$1,584.0	$1,311.1	-17.2
Total program cost	$2,264.2	$1,967.2	-13.1
Program unit cost	$6.799	$6.471	-4.8
Total quantities	333	304	-8.7
Acquisition cycle time (months)	107	107	0.0

According to the program office, the NMT's critical technologies will be mature and its design stable by its July 2010 production decision. The two critical technologies are nearing maturity. Almost 100 percent of the program's design drawings are releasable. The NMT program has identified three critical manufacturing processes. According to the program office, the contractor has not yet demonstrated these processes are in control because production has not begun. The program began producing engineering development models in May 2008 and anticipates testing these models in February 2010. The NMT's full operational capability has been delayed 2 years to 2017 due to changes in the NMT's procurement and installation schedule that were made in 2008 to align the program with the naval operations resources and objectives.



NMT Program

Technology Maturity

The NMT program's two critical technologies—a multi-band antenna feed and monolithic microwave integrated circuit power amplifiers for Q-band and Ka-band communication frequencies—are nearing maturity. Design Verification Test is complete on the multi-band feeds, demonstrating their ability to communicate in the frequencies desired, and the program office expects these technologies to be fully mature before the production decision in Summer of 2010. According to the program office, the backup technologies are older versions of the same technologies, and if these older technologies are needed, the program could experience a challenge in repackaging them in a more efficient form.

Design Maturity

The NMT's design is stable. As of August 2009, almost 100 percent of the program's total expected drawings were releasable. The program has also released all of the technical data packages necessary to build the NMT's engineering development models. The first development test of a fully configured, integrated engineering development model is expected to take place in February 2010. The NMT program held an earlier design review in May 2005 for NMT prototypes from two contractors, who were competing to build the engineering development models. DOD has stated that having competing contractors produce prototypes to demonstrate key systems elements is a good practice for lowering a program's technical risk, among other benefits.

The NMT program's software lines of code have significantly increased since the start of development to accommodate software communications architecture requirements. Currently, software integration testing is over 80 percent complete and 95 percent of the defects discovered have been resolved. The NMT program is also containing most of the defects that it finds within the phase of software development in which they occurred. This is a good indicator because it is more efficient to correct problems within the phase in which they occur.

Production Maturity

The NMT program office has identified three critical manufacturing processes—a first step in assessing production maturity—for the NMT program. However, the contractor has not yet demonstrated that these processes are in control. According to the program office, statistical process control data is not available for NMT since production has not begun. The three critical manufacturing processes were identified during the program's June 2008 technology readiness assessment and are related to the Q-band and Ka-band monolithic microwave integrated circuits and the Q/Ka radome.

Other Program Issues

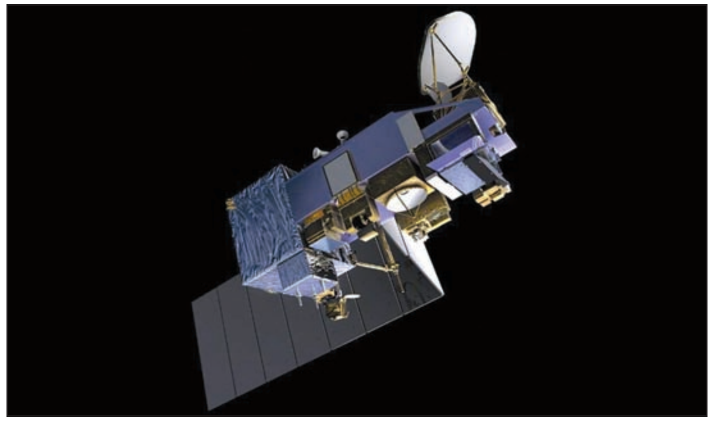
The NMT program may encounter challenges in developing and fielding the system. The full capability of the NMT program depends upon the successful launches of Advanced Extremely High Frequency (AEHF) satellites. The AEHF program anticipates launching its first satellite in 2010, 2 years later than originally projected, and it will not reach initial operational capability until 2013. While delays with AEHF capability directly affect the ability of the NMT program to test the new higher data rate communications capability, the NMT terminal can provide value to the fleet upon fielding by accessing existing satellite communication systems such as the Defense Satellite Communications System, Milstar, and Wideband Global SATCOM. The NMT program is still projecting a 2-year delay in realizing its full operational capability. NMT program officials stated that this delay is due to changes in NMT's procurement and installation schedule that were made to better align the program with naval operations resources and objectives.

Program Office Comments

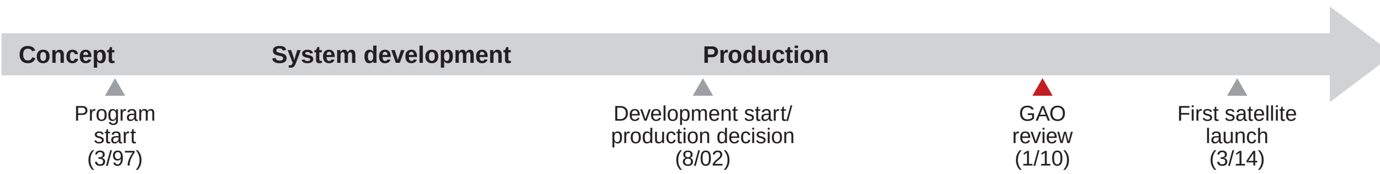
In commenting on a draft of this assessment, the Navy stated that the NMT program is successfully executing to provide deployed naval commanders with assured access to secure, protected, command and control, communication capabilities to support the exchange of warfighter critical information. It will support the Navy's Net-Centric FORCEnet architecture and act as an enabler for transforming operational capability available to the warfighter. The Navy also provided technical comments, which we incorporated as appropriate.

National Polar-orbiting Operational Environmental Satellite System (NPOESS)

NPOESS is a tri-agency—Department of Commerce (National Oceanic and Atmospheric Administration), DOD, and National Aeronautics and Space Administration—satellite program to monitor the weather and environment through the year 2026. Current NOAA and DOD satellites will be merged into a single national system. NOAA and DOD each provide 50 percent of the funding for NPOESS. The program consists of four segments: space; command, control, and communications; interface data processing; and the launch segment. We assessed the space segment.



Source: Courtesy of Northrop Grumman.



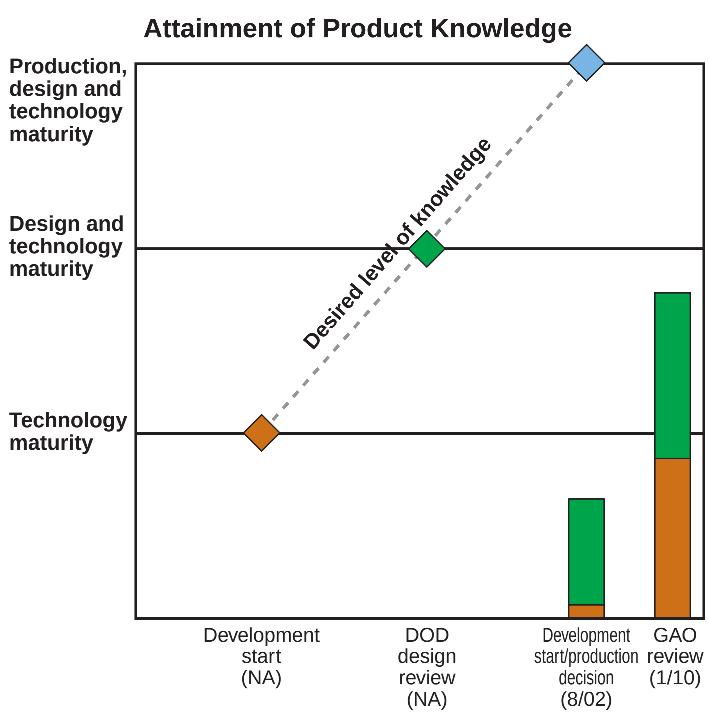
Program Essentials

Prime contractor: Northrop Grumman Space Technology
Program office: Silver Spring, MD
Funding needed to complete:
- R&D: $3,382.7 million
- Procurement: $3,847.7 million
- Total funding: $7,230.4 million
- Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of 08/2002	Latest 11/2009	Percent change
Research and development cost	$5,181.5	$9,313.8	79.8
Procurement cost	$1,337.6	$3,847.7	187.7
Total program cost	$6,519.1	$13,161.5	101.9
Program unit cost	$1,086.521	$3,290.377	202.8
Total quantities	6	4	-33.3
Acquisition cycle time (months)	113	193	70.8

In August 2002, the program began development and production before achieving technology maturity, design stability, or production maturity. In July 2007, the NPOESS program was restructured in response to a Nunn-McCurdy unit cost breach of the critical threshold. As part of the restructure, 7 of the original 14 critical technologies were removed from the program. Of the remaining technologies, all 7 are reported mature by program officials. While the restructure's goal was to lower future cost and schedule risks, it increased the risk of a satellite coverage gap and significantly reduced data collection capabilities.



NPOESS Program

Technology Maturity

NPOESS's began development in August 2002 with 1 of 14 critical technologies mature. Seven technologies have been removed from the program. According to program officials, the 7 remaining technologies are mature.

Three of the five sensors slated for the NPOESS demonstration satellite, NPOESS Preparatory Project (NPP), have been delivered and integrated on the spacecraft, but the launch of NPP continues to be delayed due to problems with a critical sensor. The launch of NPP, initially planned for May 2006, is not expected to occur until at least September 2011. The satellite is expected to demonstrate the performance in a realistic environment of three critical sensors that provide data for key weather products and two noncritical sensors.

Design Maturity

The NPOESS program made a decision to begin production in 2002 before achieving design stability. At the latest design review in April 2009, the design was nearly stable with 86 percent of an estimated 6,488 total drawings releaseable.

Production Maturity

We could not assess production maturity. The program office does not collect statistical process control data due to the small number of satellites to be built. Program officials stated that contractors track various metrics for subcomponent production, such as rework percentages, defect containment, and schedule and cost performance, but the program has not set goals for these metrics.

Contract Management

In June 2009, we reported that NPOESS's approved cost and schedule baseline was not achievable, due in part to continued problems with two critical sensors. Since the program's inception, the launch of the first satellite has slipped about 5 years—from April 2009 to about March 2014. The launch of the second satellite has been delayed from June 2011 to May 2016. We have previously reported that the delayed launches of fewer satellites could reduce satellite data collection and require dependence on a European satellite for coverage during midmorning hours. There is also an increased risk of a 3- to 5-year coverage gap for the existing constellation of satellites should there be premature satellite failures or unsuccessful launches of a Defense Meteorological Satellite Program (DMSP), NPOESS, or NPP satellite. The restructured program deleted 4 of 13 instruments and reduced the functionality of four sensors. While the program has added one sensor back to the first satellite, the NPOESS system will have significantly less capability for providing global climate and space environment measures than originally planned.

According to program officials, it is difficult for the NPOESS Executive Committee to steer three agencies' competing requirements and priorities. In July 2009, a task force within the Executive Office of the President was formed to monitor the program's progress and resolve obstacles. The National Defense Authorization Act for Fiscal Year 2010 requires the President to develop a strategy for the management and funding of NPOESS, and prohibits the Air Force from spending more than 50 percent of the funds available for NPOESS until the management and funding strategy is submitted to the relevant congressional committees.

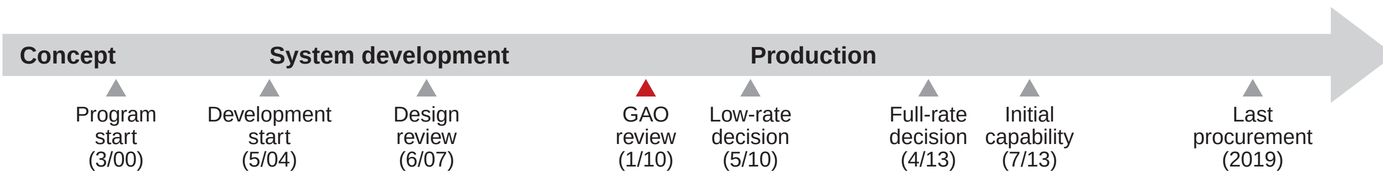
Program Office Comments

The NPOESS Integrated Program Office provided technical comments, which were incorporated as appropriate.

P-8A Poseidon (P-8A)

The Navy's P-8A Posedon is a Boeing 737 commercial derivative that will replace the P-3C. Its primary roles are antisubmarine warfare; antisurface warfare; and intelligence, surveillance, and reconnaissance. The P-8A shares an integrated maritime patrol mission with the Broad Area Maritime Surveillance Unmanned Aerial System and the EP-X (formerly the Aerial Common Sensor). These systems are intended to operate independently or in tandem to support the Navy's maritime warfighting capability.

Source: © 2008 Boeing.



Program Essentials

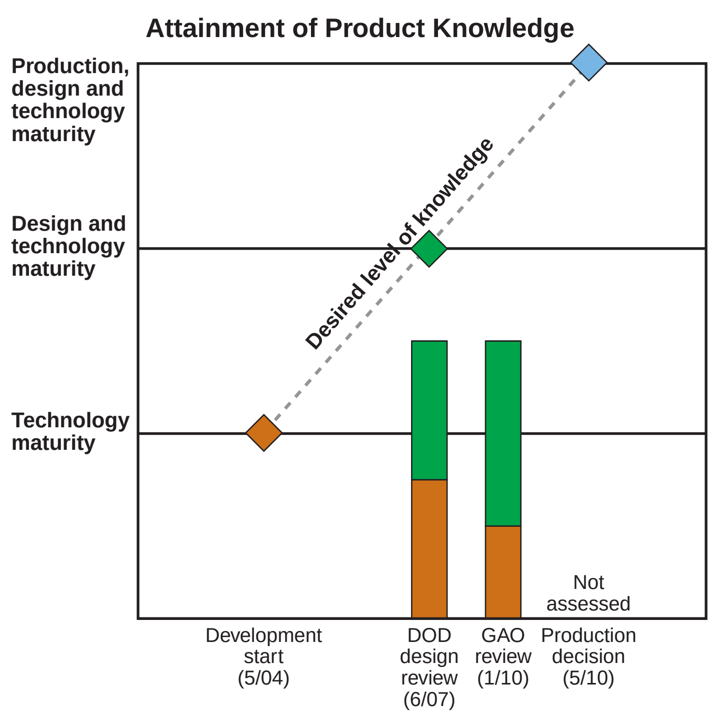
Prime contractor: The Boeing Company
Program office: Patuxent River, MD
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of 05/2004	Latest 08/2009	Percent change
Research and development cost	$7,346.4	NA	NA
Procurement cost	$22,791.2	NA	NA
Total program cost	$30,271.9	NA	NA
Program unit cost	$263.234	NA	NA
Total quantities	115	NA	NA
Acquisition cycle time (months)	160	NA	NA

The program plans to purchase an additional nine aircraft but has not yet updated the total program cost and quantity.

According to the program office, the P-8A's critical technologies will be mature and its design will be stable by its planned May 2010 production decision. The program will complete an operational assessment prior to the production decision and has begun testing to support that assessment. The P-8A's software development efforts are also nearing completion. The P-8A program has actively managed its technology risk. The program entered development with four immature critical technologies, but replaced two technologies with less capable, more mature backups. It also added a new critical technology, the Hydro-Carbon Sensor, which is considered mature in ground-based applications, but had not been demonstrated in an aircraft. According to program officials, the Navy now plans to buy nine additional aircraft for a total quantity of 122.



P-8A Program

Technology Maturity

The program entered development in 2004 with four immature critical technologies that had not been demonstrated in a relevant or realistic environment. Since then, it replaced two of those technologies with less capable, more mature backups that still meet P-8A requirements. The program currently considers two technologies—the Hydro-Carbon Sensor and the ESM Digital Receiver—to be critical. According to the program office, both technologies will be mature and demonstrated in a realistic environment by its planned May 2010 production decision. Both technologies were assessed during a September 2008 technology readiness assessment. The ESM Digital Receiver was considered mature, while the Hydro-Carbon Sensor was considered mature in ground-based applications, but had not been demonstrated in an aircraft. The program will conduct another technology readiness assessment prior to its low-rate initial production decision.

The P-8A program is following an incremental approach. At present, the program has not identified any additional critical technologies for delivering the second increment of capability, which, according to the program office, involves accoustics and to communications, improvements, and upgrades to the tactical support center.

Design Maturity

The P-8A's design is stable, with 99 percent of its design drawings released. Software development efforts are 97 percent complete, and program officials stated that the program has experienced a lower rate of software defects than anticipated. According to program officials, the program has also pursued a strategy of building, testing, and fixing software issues as they arise, rather than waiting until software development efforts are complete.

Production Maturity

The P-8A program recently awarded a contract for long lead materials for low-rate initial production. While we did not assess production maturity, the program is tracking scrap/re-work rates for production. Currently, the scrap / rework rate is above the goal for the Boeing production facility, but program officials said that they expect to reach the target rate as production proceeds. The program has mitigated potential schedule effects from the 2008 labor strike at Boeing.

Other Program Issues

The P-8A program will complete an operational assessment prior to its planned May 2010 production decision. However, the assessment will not include flight test results. In order to minimize on-aircraft testing, program officials stated that the program will be using a weapon system integration lab (WSIL) equipped with production representative hardware for the testing that supports the operational assessment. According to a Navy testing official, while it would be preferable to have flight test results for the operational assessment, the program planned from an early date to use data from the WSIL, as well as known information about the 737 aircraft. The program has begun testing the first flight test aircraft.

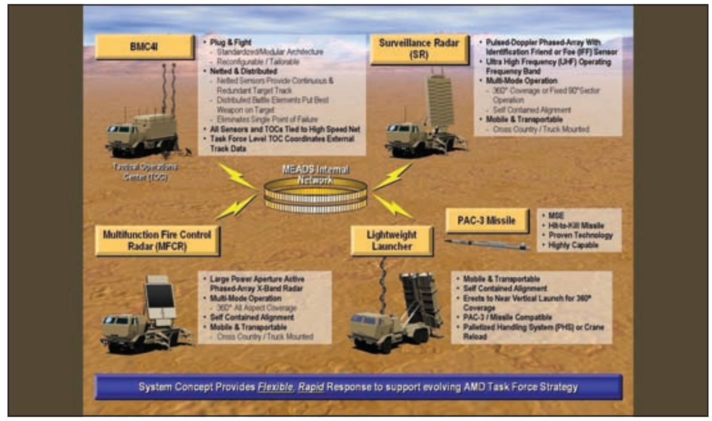
According to program officials, the Navy now plans to purchase nine additional aircraft for a total of 122; a decision that was made as a result of a long term planning study conducted by the Navy. The procurement cost of the program will increase to account for the additional aircraft. Although development contract costs have already risen from $3.9 billion to $5.6 billion as a result of delays in design drawing release, additional costs to mitigate software development risks, strike recovery efforts, and funding for the second increment of capability, program officials have said that they have been able to stay within the cost estimates in the program's original baseline.

Program Office Comments

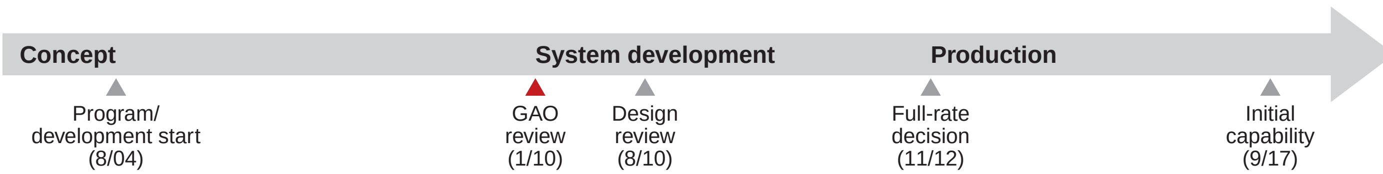
In its comments, program officials said that the program continues to meticulously manage the critical technologies. The program has continually assessed the technologies constituting the P-8A in order to identify new candidate critical technologies that require additional management attention. The maturation of the P-8A technologies is on schedule to support the production decision. As an example, the Hydro-Carbon sensor is now assessed by the program as mature due to completion of developmental testing per the maturation plan. Although contract costs have grown since the original proposal, they still remain below the program's cost estimate at the start of development. The program continues to manage within the trade space for cost, schedule, and performance parameters as defined in the P-8A acquisition program baseline agreement.

PATRIOT MEADS Combined Aggregate Program (CAP) Fire Unit

The Army's Patriot / Medium Extended Air Defense System (MEADS) Combined Aggregate Program transitions the Patriot missile system to MEADS. MEADS is intended to provide low- to medium-altitude air and missile defense to counter, defeat, or destroy tactical ballistic missiles, cruise missiles, or other air-breathing threats. MEADS is being developed by the United States, Germany, and Italy. We assessed the MEADS fire unit, including launchers, radars, battle management component, and launcher reloaders. We did not assess the Patriot missile.



Source: US MEADS National Product Office.



Program Essentials

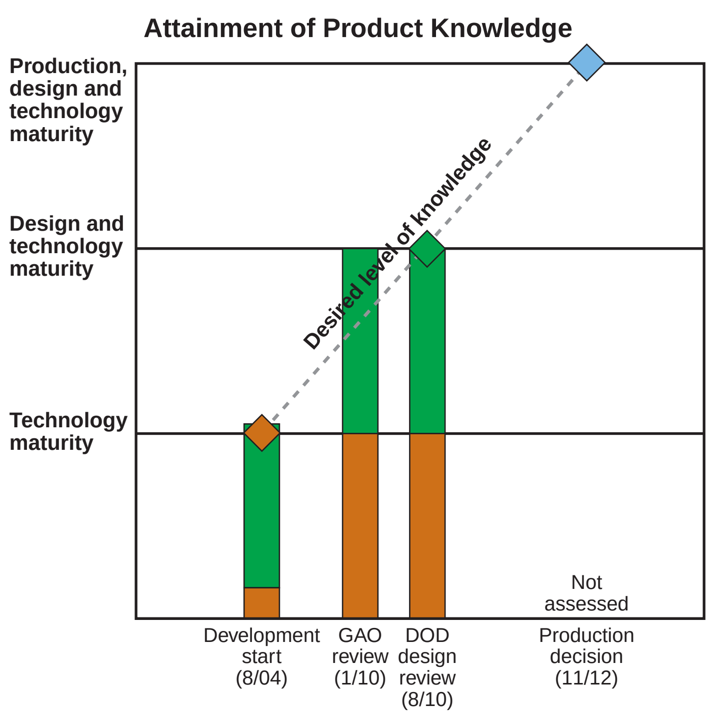
Prime contractor: MEADS International
Program office: Huntsville, AL.
Funding needed to complete:
- R&D: $3,393.4 million
- Procurement: $13,101.2 million
- Total funding: $16,494.6 million
- Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of 08/2004	Latest 01/2010	Percent change
Research and development cost	$5,177.6	$4,880.3	-5.7
Procurement cost	$13,710.1	$13,101.2	-4.4
Total program cost	$18,887.7	$17,981.5	-4.8
Program unit cost	$393.493	$374.614	-4.8
Total quantities	48	48	0.0
Acquisition cycle time (months)	157	157	0.0

According to program officials, the program's cost and schedule will be rebaselined in 2010 to reflect changes in the program.

All five of the Patriot/MEADS Combined Aggregate Program fire unit's critical technologies are fully mature. The program held a preliminary design review in 2007 and is conducting an incremental critical design review that it expects to complete with a system-level review in August 2010. Program officials estimate they have released about 90 percent of the total expected drawings for the system. The program has produced hardware prototypes. According to program officials, the program is expected to be extended by 18 months due, in part, to issues revealed during the preliminary design review period with requirements for the sensor and underestimation of the cost of the effort. Program officials stated that they expect to rebaseline the program once cost and schedule changes are final.



PATRIOT MEADS CAP Fire Unit Program

Technology Maturity

All five of MEADS critical technologies are reported as fully mature. According to program officials, both the Launcher Electronics and the Tactical Exciter have made significant progress since program inception, especially the U.S.-developed and produced exciter. Officials also stated that the first Tactical Exciter was delivered in late fiscal year 2009 and has already started integration in Germany into the Multifunction Fire Control Radar system; the second Tactical Exciter is scheduled for delivery mid-fiscal year 2010.

Design Maturity

The program office expects the system's design to be stable by its August 2010 system level design review. According to MEADS program officials, the program has released 92 percent of the total expected design drawings across five major end items (MEI). More than the 90 percent of the drawings for two of the five MEIs—the launcher and the Multifunction Fire Control Radar—are releasable. For the remaining three MEIs—the Battle Management, Command, Control, Communications, Computer, and Intelligence software and hardware, the reloader, and the Surveillance Radar—88 percent or more are releasable. The program is currently undergoing an incremental critical design review process and has completed 30 of 46 critical design review events.

Production Maturity

We did not assess production maturity because the program will not enter production until 2012. Program officials noted that numerous hardware and software prototypes have been built, and much of the hardware is well beyond the prototype phase. For example, according to MEADS officials, over 16,000 X-band transmit/receive modules have been delivered. The program office does not collect statistical process control data at the MEI level, but, according to officials, contractors do collect statistical process control data for some component parts.

Other Program Issues

MEADS officials expect the program's design and development phase to be extended by 18 months due in part to issues with Battle Management Command, Control, Communications, Computers and Intelligence and sensor requirements and an underestimation of the sensor development effort. This schedule extension includes an 11-month delay in the system level critical design review from October 2009 to August 2010. Due to the schedule extension, the program will need to be rebaselined. Program officials stated that the cost increase associated with the schedule extension is expected to be shared among the three member nations. However, part of the program extension includes breaking the program into two phases—a critical design review phase and a postcritical design review phase. According to program officials, this was done primarily to allow the member nations to minimize their liability if they decide not to continue with the program after the critical design review. Details regarding the 18-month extension were not available as negotiations had not begun among the member nations, nor had they agreed to a memorandum of understanding.

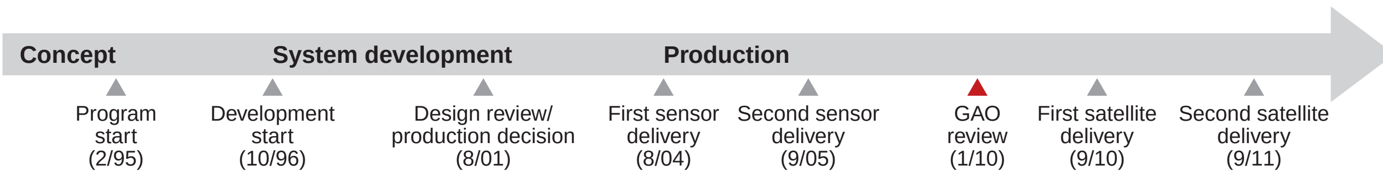
Program Office Comments

In commenting on a draft of this assessment, the program office stated that the International MEADS program is over 5 years into development and has successfully completed System Requirements and Preliminary Design reviews. All five of the highlighted critical technologies are progressing satisfactorily. A contract amendment to mitigate program concerns and rebaseline the post-CDR phase is on track for national decisions in early fiscal year 2011. The planned schedule extension reduces program risk, facilitates added integration activities, and facilitates successful CDR completion. Cost growth continues to be a concern for the Army, when considered in today's limited resource environment. The program office also provided technical comments, which were incorporated as appropriate.

Space Based Infrared System (SBIRS) High

The Air Force's SBIRS High satellite system is being developed to perform a range of missile warning, missile defense, technical intelligence, and battlespace awareness missions. A planned replacement for the Defense Support Program, SBIRS High is a constellation of four satellites in geosynchronous earth orbit (GEO), two sensors on host satellites in highly elliptical orbit (HEO), and fixed and mobile ground stations. In 2007, DOD authorized the Air Force to procure two additional HEO sensors. We assessed the space segment.

Source: © 2007 Lockheed Martin Corporation.



Program Essentials

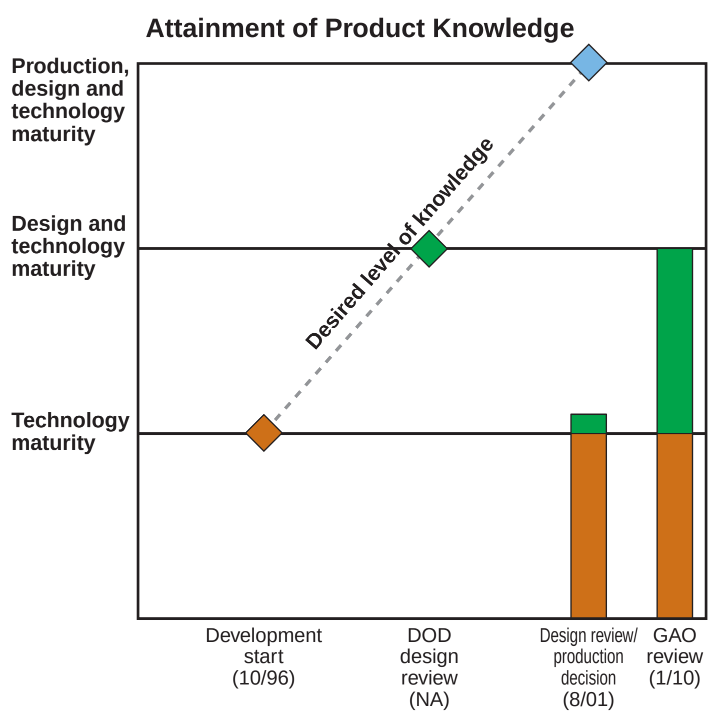
Prime contractor: Lockheed Martin Space Systems Company
Program office: El Segundo, CA
Funding needed to complete:
- R&D: $1,404.7 million
- Procurement: $1,392.0 million
- Total funding: $2,829.4 million
- Procurement quantity: 1

Program Performance (fiscal year 2010 dollars in millions)

	As of 10/1996	Latest 10/2009	Percent change
Research and development cost	$4,261.7	$9,583.3	124.9
Procurement cost	$0.0	$3,816.0	0.0
Total program cost	$4,471.1	$13,638.4	205.0
Program unit cost	$894.227	$3,409.609	281.3
Total quantities	5	4	-20.0
Acquisition cycle time (months)	TBD	TBD	TBD

The 1996 data show no procurement cost as the Air Force planned to use research and development funds to buy all five satellites. We could not calculate cycle time because the program stopped reporting an initial operational capability date in 2006.

The SBIRS High program continues to experience setbacks that could add to cost overruns and schedule delays. All three of the program's critical technologies are mature and 99 percent of the expected drawings are releasable. However, program costs continue to increase due to software development problems, hardware quality issues, and testing delays on the first GEO satellite. Unplanned work continues to be a challenge for the software development effort. The program also recently discovered hardware defects on the first GEO satellite. The Air Force's best-case estimate is that the first GEO satellite launch will be delayed an additional year from December 2009 to December 2010. The HEO payloads continue to perform well on-orbit, and according to program officials, they were accepted for specific mission operations in 2009.



SBIRS High Program

Technology Maturity

The SBIRS High program began system development in 1996 with none of its three critical technologies mature. All three critical technologies—the infrared sensor, thermal management, and on-board processing—are now mature and have been demonstrated in at least a relevant environment. Furthermore, according to the program office, the HEO sensor's on-orbit performance instills confidence that the GEO infrared scanning sensor will work as intended.

Design Maturity

The SBIRS High design was not stable when the program committed to production in 2001. According to program officials, 99 percent of the SBIRS High expected design drawings are now releasable. However, the program continues to experience design-related problems, and more could emerge. For example, flight software design problems have plagued the program for several years, causing cost increases and schedule delays, and the program may still be underestimating the amount of work that remains to resolve the issues. According to the Defense Contract Management Agency (DCMA), unplanned work continues to be a challenge for the software development effort and its cost and schedule have been assessed as high risk. In addition, during functional testing of the payload and spacecraft in early 2009, the program found solder fractures on hardware components. The program conducted a root cause analysis and determined that these defects will not require design changes.

Production Maturity

We could not assess production maturity because the contractor does not collect statistical process control data. The program tracks and assesses production progress by reviewing monthly test data and updates.

Other Program Issues

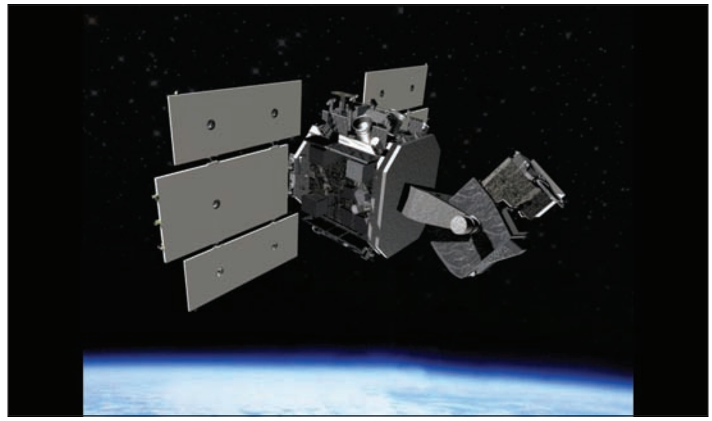
The SBIRS High program remains at high risk for cost and schedule growth. DCMA is currently projecting over $245 million in cost overrun from the current baseline at contract completion. This amount has more than doubled in the past year and continues to steadily grow. In December 2009, program officials began coordination to rebaseline the program to more realistic cost and schedule goals. Air Force officials expect the rebaselining effort to take about 9 months, and be completed in mid-to-late 2010. Additional contractor cost increases and schedule delays are expected due in part to hardware rework on the first satellite, continued difficulty with the flight software development, and delays in integration and test activities. The program's management reserve—funds set aside to address unanticipated problems—will likely be depleted before the first GEO satellite launches, and additional funding could be required if future problems occur. Additional schedule delays could also occur since meeting current launch estimates depends on the results of system-level integration tests.

Program Office Comments

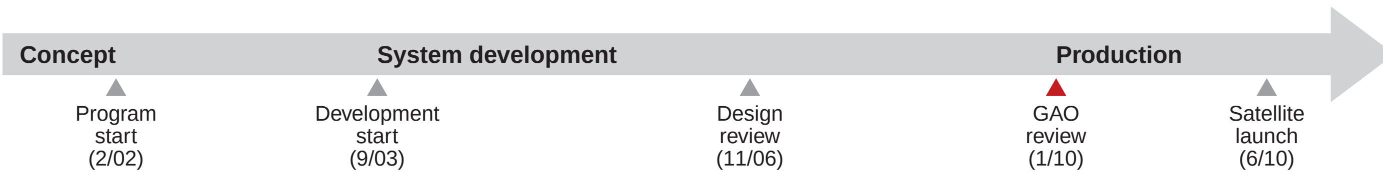
According to the program office, the first GEO integrated payload and spacecraft successfully completed thermal vacuum (TVAC) testing in November 2009. Program officials say these testing results give them high confidence that the GEO satellite will perform similarly to the successful HEO sensors, noting that HEO TVAC test performance differed only slightly from its on-orbit performance. The program recently identified the root cause of the hardware solder defects and concluded that the units to be installed on the first GEO satellite are flightworthy. Program officials say that although technical issues discovered during testing have increased program cost, parallel activities have actually minimized program cost and schedule growth. They further stressed that mission assurance remains their top priority.

Space-Based Space Surveillance Block 10

The Air Force's Space-Based Space Surveillance (SBSS) Block 10 satellite is intended to provide a follow-on capability to the Midcourse Space Experiment / Space Based Visible sensor satellite, which ended its mission in July 2008. SBSS will consist of a single satellite and associated command, control, communications, and ground processing equipment. The SBSS satellite is expected to operate 24 hours a day, 7 days a week, to collect positional and characterization data on earth-orbiting objects of potential interest to national security.



Source: Boeing.



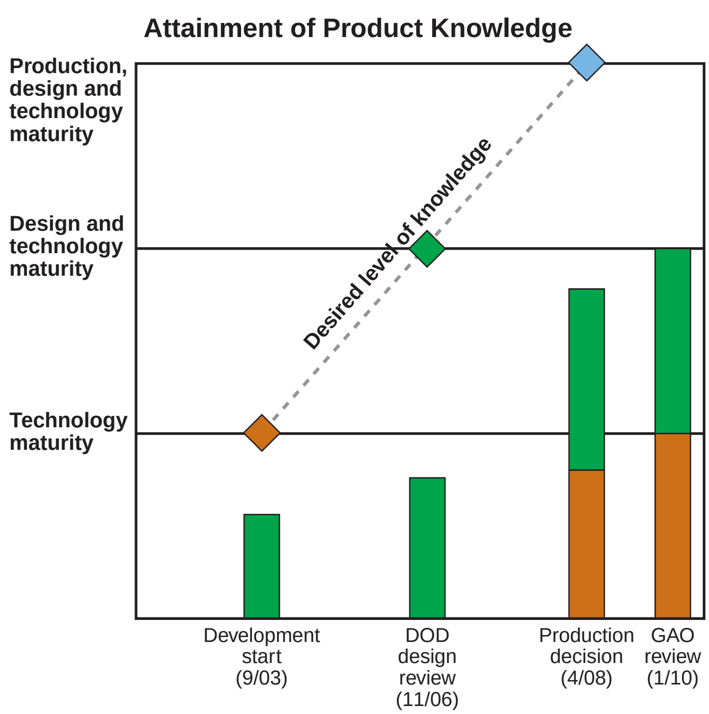
Program Essentials

Prime contractor: Ball Aerospace, Boeing, Northrop Grumman Mission Systems
Program office: Los Angeles, CA
Funding needed to complete:
R&D: TBD
Procurement: TBD
Total funding: TBD
Procurement quantity: 0

Program Performance (fiscal year 2010 dollars in millions)

	As of 01/2008	Latest 07/2009	Percent change
Research and development cost	$850.7	$873.2	2.7
Procurement cost	$0.0	$0.0	0.0
Total program cost	$850.7	$873.2	2.7
Program unit cost	$850.7	$873.2	2.7
Total quantities	1	1	0.0
Acquisition cycle time (months)	NA	NA	0.0

The SBSS Block 10 satellite is fully assembled and completed testing in March 2009. However, it is not expected to launch until at least June 2010—3 years later than originally planned—due in part to launch vehicle issues unrelated to the SBSS satellite. The Air Force is currently assessing its launch vehicle options for SBSS. The SBSS program started development in 2003 with none of its five critical technologies mature. The technologies were tested in a relevant environment as a fully assembled satellite in March 2009. The program was restructured in 2006 after an independent review found that the program's requirements were overstated and its cost and schedule targets could not be met. The Air Force is currently planning for a full and open competition for the SBSS Follow-On program.



SBSS Block 10 Program

Technology, Design, and Production Maturity

The SBSS Block 10 program's critical technologies are mature and its design is stable. The SBSS program began development in late 2003 with none of its five critical technologies mature. According to the program office, all five critical technologies have now been demonstrated in a relevant environment. The satellite completed testing in March 2009. According to the program office, the SBSS design is also stable with 100 percent of the space vehicle design drawings released to manufacturing. We could not assess production maturity because the program office did not collect statistical process control data.

Other Program Issues

The SBSS satellite is fully assembled and completed testing in March 2009. However, it is not expected to launch until at least June 2010—3 years later than originally planned—due in part to launch vehicle issues unrelated to the SBSS satellite. The Air Force began an examination of the Minotaur IV launch vehicle in February 2009 after a launch failure involving a launch vehicle with commonalities. Subsequently, Air Force officials discovered an issue with the vehicle's third-stage gas generator which could affect the successful placement of the SBSS satellite in its operational orbit. According to the program office, an independent review team is assessing the risks associated with launching the SBSS satellite on the Minotaur IV. Additionally, program office officials and the SBSS contractors are studying the feasibility of launching the SBSS satellite on a Delta II rocket. Changing launch vehicles could require interface design changes to the SBSS satellite. Both reviews are expected to be completed in February 2010.

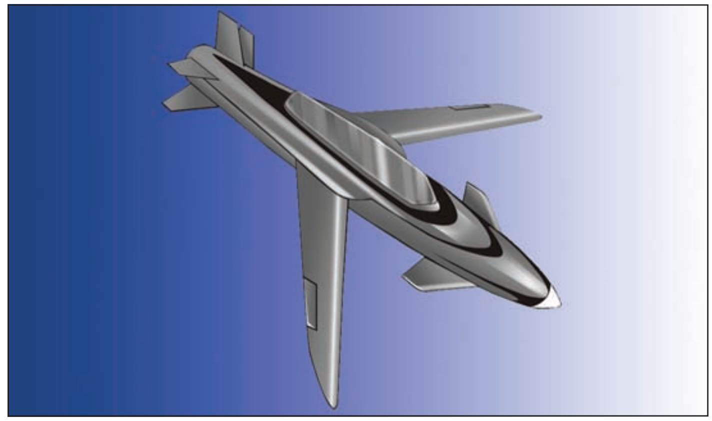
The Air Force is currently planning a full and open competition for an SBSS Follow-On program. Parts obsolescence could be a factor in this decision. However, we have reported that existing spare parts could be used to help build a second SBSS Block 10 satellite. Relying on the existing Block 10 design could reduce the risk of the follow-on effort and, consequently, the risk of a gap in space surveillance capabilities. According to the program office, SBSS Block 10 lessons learned will serve as a critical foundation in follow-on SBSS acquisition efforts. However, the SBSS program plans to begin concept refinement activities for the follow-on effort before the SBSS Block 10 satellite is launched. The Air Force is assessing statements of capability from industry and plans to issue a request for proposal in summer 2010 and award a contract in mid-2011 for the follow-on effort. The program is projecting a 2015 launch for a follow-on satellite.

Program Office Comments

In commenting on a draft of this assessment, the program office stated that the SBSS Block 10 system achieved launch readiness in October 2009. The program office is focused on risk reduction efforts for launch, operations, and sustainment. The SBSS program office provided technical comments, which were incorporated as appropriate.

Small Diameter Bomb (SDB), Increment II

The Air Force's Small Diameter Bomb (SDB) Increment II is planned to provide the capability to attack mobile targets from standoff range in adverse weather. It is planned to combine radar, infrared, and guidance sensors in a terminal seeker using GPS and an inertial navigation system to achieve precise guidance accuracy in all weather. SDB II will be integrated with the Air Force F-15E and the Navy and Marine Corps Joint Strike Fighters, and is designed to integrate with other aircraft, such as the F-22A.



Source: SDB II Program Office.

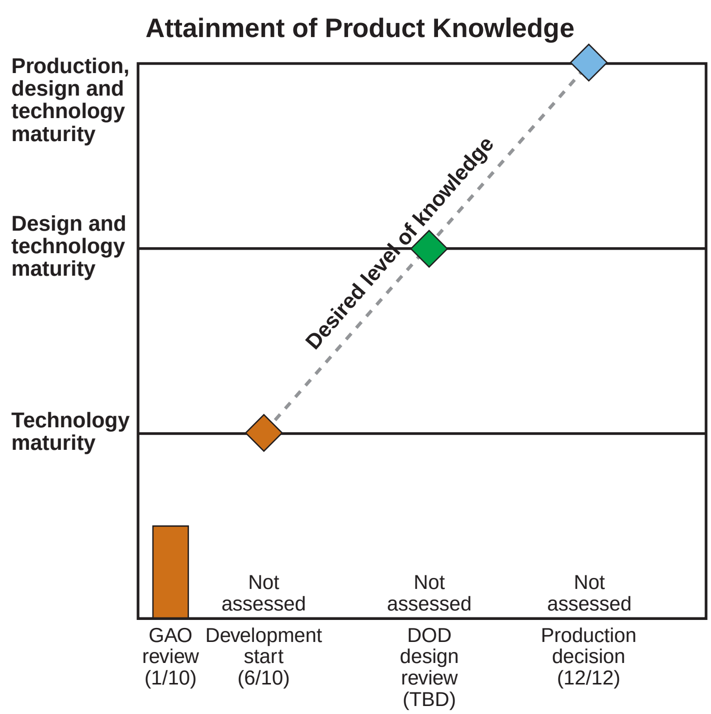
Program Essentials

Prime contractor: Boeing, Raytheon
Program office: Eglin AFB, FL
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: TBD

Program Performance (fiscal year 2010 dollars in millions)

	As of	Latest 07/2009	Percent change
Research and development cost	NA	NA	NA
Procurement cost	NA	NA	NA
Total program cost	NA	NA	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

The SDB II program is scheduled to enter engineering and manufacturing development in June 2010. The program has completed a 42-month risk reduction effort and is currently in source selection. An independent technology readiness assessment will be completed prior to the SDB II program's entry into engineering and manufacturing development. According to program officials, the critical technologies for one or both of the competing contractors are expected to be nearing maturity and demonstrated in relevant environment prior to development start. According to DOD's acquisition policy, if this does not occur, the program must use an alternative technology that has reached this level of maturity or modify the system's requirements. The program plans to award a fixed price contract for development in June 2010.



SDB II Program

Technology Maturity

The SDB II program is scheduled to enter engineering and manufacturing development in June 2010. The program has completed a 42-month risk reduction effort and is currently in source selection. An independent technology readiness assessment will be completed prior to the SDB II program's entry into engineering and manufacturing development. According to program office officials, the critical technologies for one or both of the competing contractors are on track to be demonstrated in a relevant environment prior to development start.

Other Program Issues

The SDB II program has completed its 42-month risk reduction effort. For this phase, the Air Force awarded separate risk-reduction contracts to Boeing and Raytheon. The contractors have proposed system performance specifications as part of this effort that will be evaluated as part of the source selection. A request for proposal was issued in October 2009 and the contractors will compete for a fixed price incentive contract for engineering and manufacturing development with options for production. The program plans to award the contract not later than June 2010. According to program officials, during development the contractor will be accountable for system performance, which includes designing the weapon system and planning the developmental test program to verify system performance.

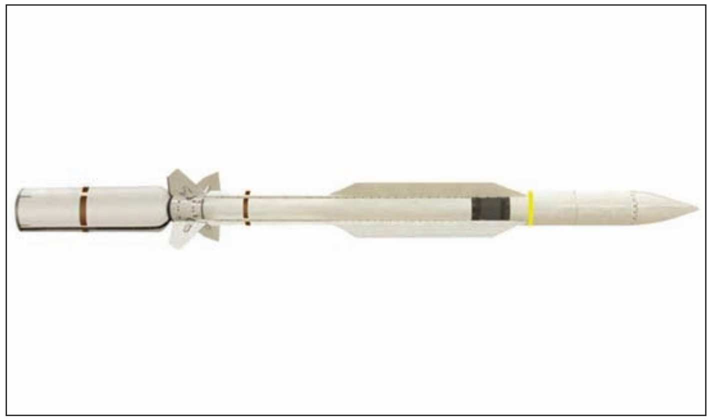
Integration with the Joint Strike Fighter carrier and short takeoff vertical landing variants is a requirement for the program. According to program officials, this is a risk for the SDB II development effort because of the concurrency between the two programs. The SDB II program office suggested breaking out SDB II integration on the Joint Strike Fighter into a separate development path at a November 2008 configuration steering board to address this risk. However, program officials stated the Under Secretary of Defense for Acquisition, Technology, and Logistics kept the JSF integration requirement as part of the baseline program when it approved the SDB IIs acquisition strategy in September 2009.

Program Office Comments

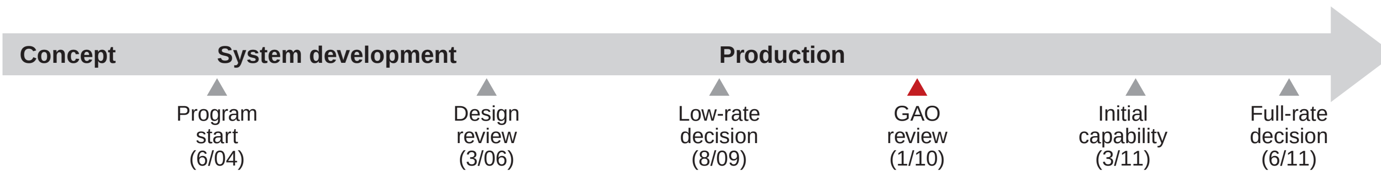
In commenting on a draft of this assessment, program officials stated the original contracting strategy was to use a cost plus fixed fee with performance incentive for development. This strategy was changed after a DOD review and an Air Force acquisition strategy panel were held. In September 2009, DOD approved an acquisition strategy for the program that included a fixed price with incentive fee contract for development. According to the program office, the contract type provides a calculable incentive for the contractor to control costs, as well as a ceiling price to limit the government's liability for cost growth. The program office also provided technical comments, which were incorporated where appropriate.

Standard Missile-6 Extended Range Active Missile

The Navy's Standard Missile-6 (SM-6) is a surface-to-air missile launched from Aegis destroyers and cruisers. It is designed to provide anti-air warfare and anti-cruise missile ship self-defense, fleet area defense, and theater air defense. In addition to extended range, the initial SM-6 Block I will have an active missile seeker, countermeasures resistance, and "Engage-On-Remote" (EOR) intercept capability. The program is using an incremental approach to produce Block I, with additional blocks intended to meet future threats.



Source: Raytheon Missile Systems.



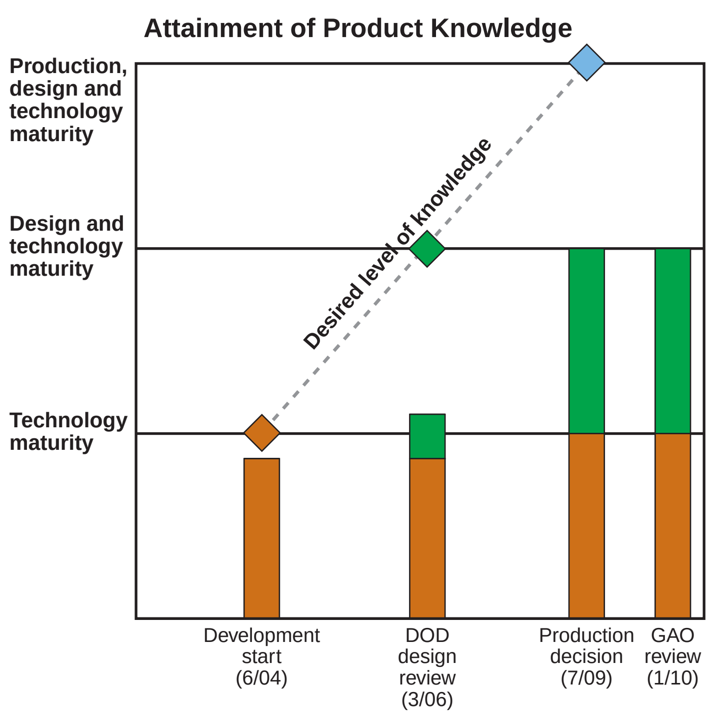
Program Essentials

Prime contractor: Raytheon Missile Systems
Program office: Arlington, VA
Funding needed to complete:
R&D: $182.0 million
Procurement: $4,837.1 million
Total funding: $5,019.1 million
Procurement quantity: 1,181

Program Performance (fiscal year 2010 dollars in millions)

	As of 07/2004	Latest 08/2009	Percent change
Research and development cost	$1,047.4	$954.8	-8.8
Procurement cost	$4,512.8	$4,958.4	9.9
Total program cost	$5,560.2	$5,913.2	6.3
Program unit cost	$4.634	$4.928	6.3
Total quantities	1,200	1,200	0.0
Acquisition cycle time (months)	75	81	8.0

The SM-6 program's concurrent testing and production strategy puts the program at increased risk for cost growth and schedule delays. According to the Navy program office, all SM-6 critical technologies were mature and its design was stable by the August 2009 low-rate initial production decision. However, the SM-6 has not been flight-tested at sea or tested some of its key capabilities, such as engage-on-remote. While the SM-6 program has identified its critical manufacturing processes, it has not started to collect the data to show those processes are in control. The program is using other measures to assess the production processes associated with selected key product characteristics. About 77 percent of the hardware components of the SM-6 are legacy Standard Missile and Advanced Medium Range Air-to-Air Missile (AMRAAM) components.



SM-6 Program

Technology Maturity

The SM-6 will combine existing SM-2 Block IV propulsion and warhead sections, and a modified seeker from the AMRAAM. According to the program office, the SM-6 program started development in 2004 with five of its seven critical technologies mature and demonstrated in a realistic environment. According to a Navy technology readiness assessment, all seven SM-6 critical technologies were mature by its August 2009 production decision. Land-based developmental flight tests against targets representing anti-ship cruise missiles were successful. However, during a developmental test in January 2009, the SM-6 missile failed to launch. Post-test failure investigation identified an issue with the tactical seeker batteries which caused mission computer failure. The contractor implemented corrective actions to missile circuitry to prevent this type of failure and in August 2009 it was retested successfully. The SM-6 has not yet been flight tested at sea. As of January 2010, the first operational flight test at sea is scheduled for the fourth quarter of fiscal year 2010, following a series of combined developmental-operational tests (DT / OT) scheduled to begin in the second quarter of fiscal year 2010. Until these tests are conducted, the potential for future design changes and retrofits remain.

Design Maturity

According to the program office, all SM-6 drawings are releasable to manufacturing, indicating design stability. However, only about 22 percent of the total design drawings were releasable when the program held its design review in March 2006. The primary metric that the program office uses to assess design stability is the number of changes that affect performance requirements per month. The program office measures these changes as a percentage of the total requirements in the missile's specifications, and set a goal of less than 5 percent. According to the program office, the SM-6 met this goal for design stability at both its design and low-rate initial production reviews.

Production Maturity

Although the SM-6 program has identified its critical manufacturing processes, it has not started to collect the data to show those processes are in control. About 77 percent of the hardware components of the SM-6 are legacy Standard Missile and AMRAAM components. In the meantime, the program analytically assessed selected key product characteristics with higher risk for probability of noncompliance. In addition, prior to the low-rate initial production decision, the contractor conducted an assessment in December of 2008 to evaluate whether the overall SM-6 missile was mature enough to enter low-rate initial production using manufacturing readiness levels. The contractor concluded at the time that the manufacturing process was nearing maturity, and identified risks associated with several components and subsystems, as well as the capacity of test equipment.

Other Program Issues

The SM-6 program is pursuing a concurrent testing and production strategy that could result in costly retrofits and schedule delays if unexpected design changes are required as a result of testing. The first lot of low-rate production missiles is expected to be produced concurrently with the completion of developmental testing. In addition, the program has not yet flight tested the SM-6 at sea or tested one key capability—receiving in-flight updates from another Aegis ship (engage-on-remote).

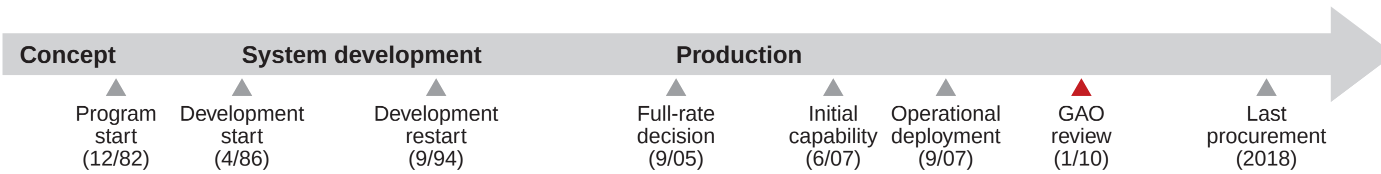
Program Office Comments

In commenting on the draft of this assessment, the SM-6 program office provided technical comments, which were incorporated as appropriate.

V-22 Joint Services Advanced Vertical Lift Aircraft

The V-22 Osprey is a tilt-rotor aircraft developed for Marine Corps, Air Force, and Navy use. The Marine Corps completed four deployments with MV-22 Block B aircraft, including one at sea. Two deployments are ongoing; the aircraft is now being used in support of operations in Afghanistan and the humanitarian effort in Haiti. The Air Force Special Operations CV-22 has completed initial operational testing and begun its initial combat deployment. Our assessment focuses on the MV-22 Block B.

Source: U.S. Marine Corps.



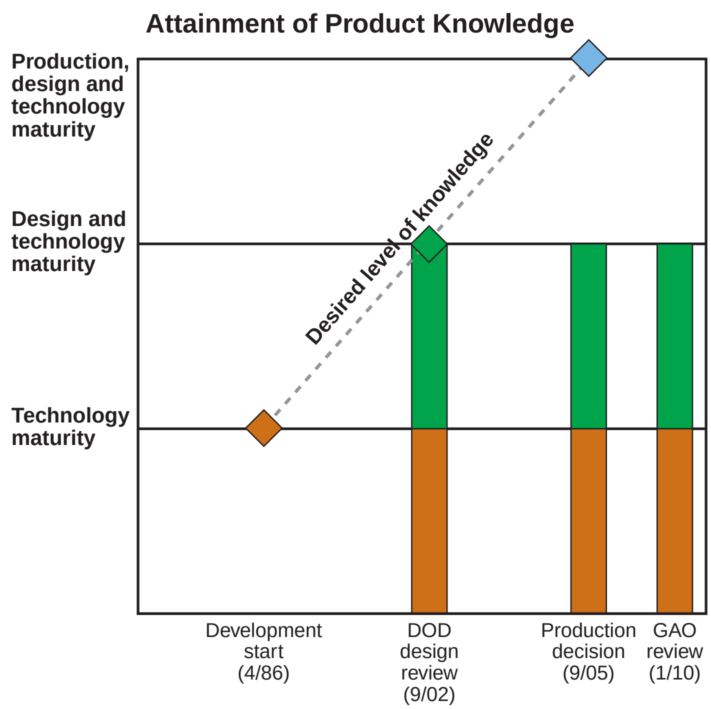
Program Essentials

Prime contractor: Bell-Boeing JPO
Program office: Patuxent River, MD
Funding needed to complete:
R&D: $320.1 million
Procurement: $22,298.7 million
Total funding: $22,719.6 million
Procurement quantity: 282

Program Performance (fiscal year 2010 dollars in millions)

	As of 04/1986	Latest 12/2008	Percent change
Research and development cost	$4,135.6	$12,805.5	209.6
Procurement cost	$34,745.8	$43,089.8	24.0
Total program cost	$39,112.3	$56,141.2	43.5
Program unit cost	$42.839	$122.579	186.1
Total quantities	913	458	-49.8
Acquisition cycle time (months)	117	291	148.7

The MV-22 completed four combat deployments, including its first shipboard deployment on board the USS Bataan. Although the aircraft was approved for full-rate production in 2005, the program continues to identify and correct deficiencies. According to program officials, fixes for some key components including the engine air filtration and ice protection systems (IPS) have been identified. Incremental IPS upgrades are being fielded on some deployed aircraft, including the V-22s currently in use in Afghanistan. In addition, eight interim defensive weapon system mission kits have been purchased with five kits currently deployed. Program officials anticipate making further improvements to these systems. Although the V-22 availability rate has improved, it still falls short of its mission capable goal and a steering committee is examining options to increase operational availability.



V-22 Program

Technology Maturity

Although the program office considers V-22 critical technologies to be mature and its design stable, the program continues to correct deficiencies and make improvements to the aircraft. For example, the engine air particle separator (EAPS), which keeps debris out of the engines, and has been tied to a number of engine fires caused by leaking hydraulic fluids contacting hot engine parts. Previous design changes did not fully correct this problem or other EAPS problems. According to program officials a root cause analysis is underway and they are exploring ways to improve reliability and safety of EAPS. Further, they believe that improved EAPS performance could reduce EAPS shutdowns and help to extend engine service life beyond its current average of 600 hours.

According to program officials the program has purchased eight belly mounted all quadrant (360 degrees) interim defensive weapon system mission kits. Five kits are currently on deployed V-22 aircraft. The aircraft has a key performance parameter (KPP) requirement to carry 24 combat equipped troops. The MV-22's shipboard pre-deployment exercise found that planning for fewer troops is needed to allow for additional space for equipment, including larger personal protective equipment. When retracted, the belly-mounted gun would reduce internal space and it will not meet the KPP of 24 combat equipped troops.

According to program officials, incremental upgrades to the IPS are being fielded in concert with an overall strategy to improve IPS reliability. These incremental upgrades are now being fielded on some deployed aircraft, including the V-22s attached to the squadron deployed to Afghanistan, where icing conditions are more likely to be encountered. The program expects to make additional improvements to the IPS which could require retrofits to existing aircraft.

Production Maturity

The V-22 is in the third year of a 5-year contract for 167 aircraft. According to the program office, the production rate will be 35 aircraft per year for fiscal years 2010 through 2012. The program is planning and budgeting for cost savings that would result from a second multiyear procurement contract that would begin in fiscal year 2013.

Other Program Issues

The MV-22's shipboard pre-deployment training revealed challenges related to required aircraft maintenance and operations. Due to the aircraft's design, many components of the aircraft are inaccessible until the aircraft is towed from its parking spot. Shipboard operations were adjusted to provide 24 hour aircraft movement capability. Temporary work-arounds were also identified to mitigate competition for hangar deck space, as well as to address deck heating issues on smaller ships caused by the V-22's exhaust. Operational restrictions were also in place that required one open spot between an MV-22 when landing or taking off and smaller aircraft to avoid excessive buffeting of the lighter helicopters caused by the downwash of the Osprey. According to program officials, another restriction that limited takeoffs and landings from two spots on LHD-class ships has since been corrected with the installation of a new flight control software upgrade. Despite the restrictions, the amphibious assault mission was concluded with half the total number of aircraft, in less time, and over twice the distance compared to conducting the mission using traditional aircraft. However, the speed, altitude, and range advantages of the MV-22 will require the Marine Corps to reevaluate escort and close air support tactics and procedures. According to the program office, during the first sea deployment in 2009, the MV-22 achieved a mission capable rate of 66.7 percent. This still falls short of the minimum acceptable (threshold) rate of 82 percent. The mission capable rate achieved during three Iraq deployments was 62 percent average. The program is also taking various steps to improve the system's overall operational availability and cost to operate by addressing premature failure of selected components and establishing a steering committee to analyze factors that affect readiness and impact operations and support costs.

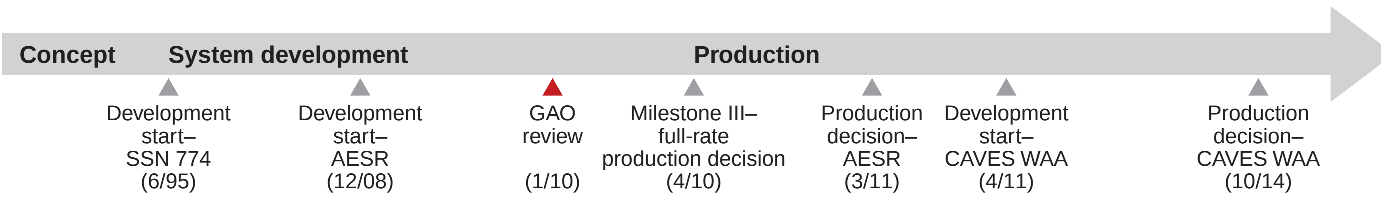
Program Office Comments

In commenting on a draft of this assessment, the V-22 program office provided technical comments, which were incorporated as appropriate.

Virginia-Class Submarine (SSN 774)

The Navy's Virginia-class attack submarine is designed to combat enemy submarines and surface ships, fire cruise missiles, and provide improved surveillance and special operations support to enhance littoral warfare. The Navy purchases the submarines in blocks and awarded its Block III construction contract in December 2008. The Navy is gradually introducing three new technologies to improve performance and lower construction costs. We assessed the status of the new technologies, cost reduction efforts, and quality assurance.

Source: U.S. Navy.



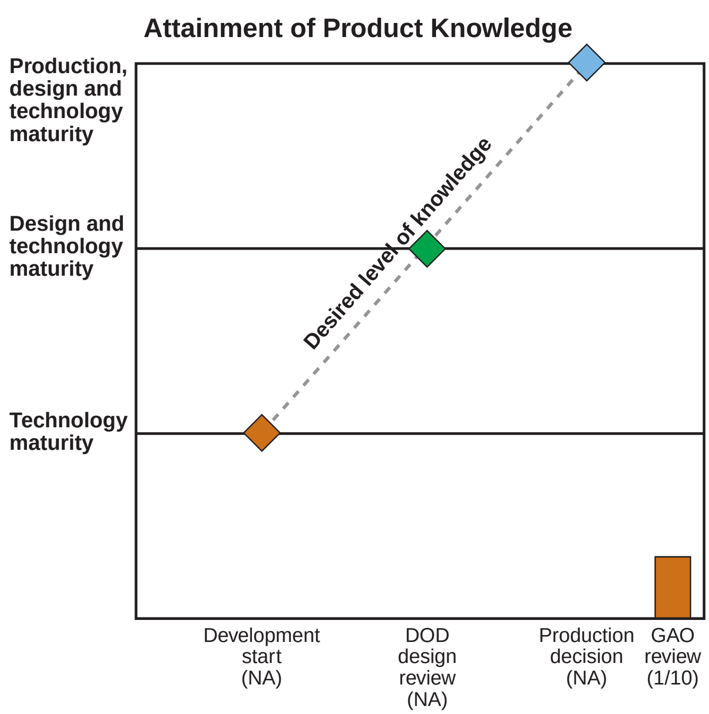
Program Essentials

Prime contractor: General Dynamics, Electric Boat Corporation
Program office: Washington, DC
Funding needed to complete:
- R&D: $867.0 million
- Procurement: $44,065.4 million
- Total funding: $44,932.4 million
- Procurement quantity: 19

Program Performance (fiscal year 2010 dollars in millions)

	As of 06/1995	Latest 08/2009	Percent change
Research and development cost	$4,392.4	$6,309.3	43.6
Procurement cost	$54,565.3	$76,073.1	39.4
Total program cost	$58,957.7	$82,382.5	39.7
Program unit cost	$1,965.258	$2,746.083	39.7
Total quantities	30	30	0.0
Acquisition cycle time (months)	134	151	12.7

The Navy is gradually introducing three new technologies—advanced electromagnetic signature reduction (AESR), a conformal acoustic velocity sensor wide aperture array (CAVES WAA), and a flexible payload sail—on new or existing submarines as they mature. In the past year, the Navy has continued to develop AESR and CAVES WAA. However, due to changes in communications requirements, the Navy is reevaluating the design of the sail and is not certain when this technology will be ready for installation. The Navy has awarded a contract for construction of eight Block III submarines. In this contract, the Navy expects to realize its goal of reducing costs to $2.0 billion (in 2005 dollars) per ship by fiscal year 2012. The Navy completed operational testing and evaluation of the Virginia-class submarine in March 2009 and plans to complete a full-rate production review in April 2010.



Virginia-Class Submarine Program

Technology Maturity

There are three new technologies that the Navy plans to incorporate on current and future Virginia Class submarines once they mature—advanced electromagnetic signature reduction (AESR), a conformal acoustic velocity sensor wide aperture array (CAVES WAA), and a flexible payload sail. AESR is a software package comprised of two systems that use improved algorithms to continuously monitor and recalibrate the submarine's signature. The basic algorithms required to support this technology have been proven on other submarines. Navy officials stated they are now developing software and conducting laboratory tests in support of further algorithm development. The Navy has completed and released about 80 percent of the software code for this technology and plans to test it on board a submarine in February 2010. The Navy will begin permanent AESR installations with SSN 782. It also plans to install the software on earlier ships when they are modernized.

CAVES WAA is a sensor array that is designed to detect the vibrations and acoustic signatures of targets. The Navy has stated that CAVES WAA could save approximately $4 million per submarine. The Navy is analyzing two options for CAVES WAA production—ceramic accelerometers, a mature but more costly technology, or fiber-optic accelerometers, a less expensive but immature technology. According to program officials, the Navy completed testing panels incorporating both types of sensors in December 2008 and plans additional at sea testing in 2010. The Navy is also considering another option, using a more mature conformal array technology manufactured for the United Kingdom's Royal Navy. The Navy is evaluating whether or not this technology is a viable candidate for installation on Virginia-class submarines.

The flexible payload sail would replace the sail atop the main body of the submarine. Due to recent changes in communications requirements, the Navy is reevaluating the design of the sail and is not certain when this technology will be ready for installation.

Production Maturity

The Navy has identified extensive quality assurance problems at one of the Virginia-class shipyards. These problems include multiple contractor errors on Virginia-class submarines, the most recent of which involved the installation of weapons loading systems. Navy officials reported that the error in the weapons loading system installation does not affect deployed submarines. The Navy continues to investigate the extent of the quality assurance problems and the potential cost and schedule implications.

Other Program Issues

The Navy expects to achieve its goal of reducing costs to $2.0 billion (in fiscal year 2005 dollars) per ship by fiscal year 2012. In December 2008, the Navy awarded a contract for construction of 8 Block III submarines bringing the total number of ships either delivered or under contract to 18. As part of this contract, the Navy plans to increase its procurement rate to two submarines per year beginning in fiscal year 2011 and anticipates this increase in procurement will generate savings of $200 million per submarine. This contract also reflects additional per-ship cost reductions. The Navy has also begun a total ownership cost reduction initiative for the program, under which the Navy will attempt to reduce the operations and support costs and other life cycle costs for future submarines.

In March 2009, the Navy completed an operational test and evaluation of the Virginia-class program and found it to be operationally effective and suitable. The Navy plans to conduct a full-rate production review in April 2010.

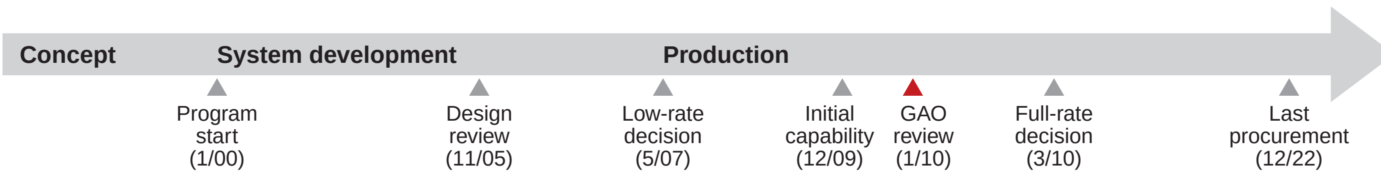
Program Office Comments

The program office provided technical comments on a draft of this assessment, which were incorporated as appropriate.

Vertical Take-off and Landing Tactical Unmanned Aerial Vehicle (VTUAV)

The Navy's VTUAV will provide real-time imagery and data to support intelligence, surveillance, and reconnaissance requirements. A VTUAV system is composed of up to three air vehicles with associated sensors, two ground control stations, one recovery system, and spares and support equipment. The air vehicle launches and recovers vertically, and operates from ships and land. The VTUAV is being designed as a modular, reconfigurable system to support various operations that may include surface, antisubmarine, and mine warfare.

Source: © 2006 Northrop-Grumman Corporation.



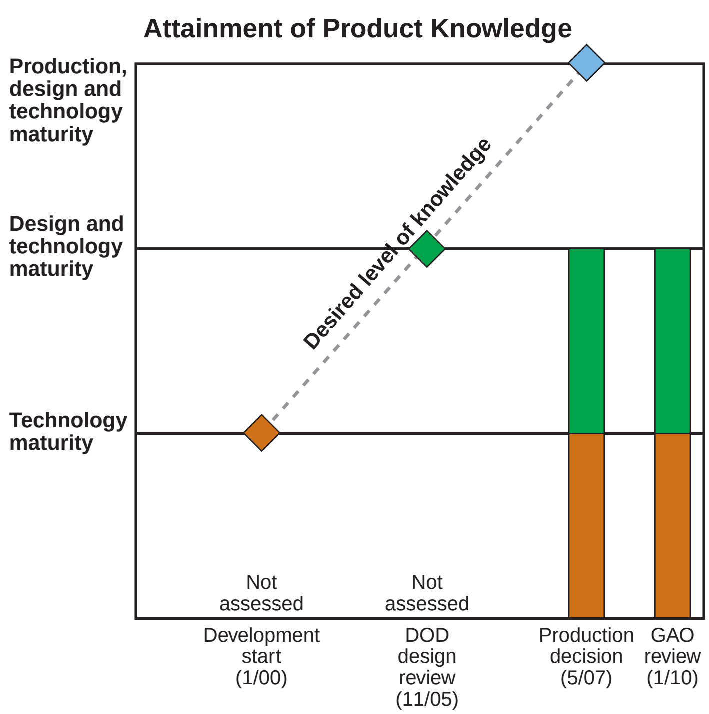
Program Essentials

Prime contractor: Northrop Grumman
Program office: Patuxent River, MD
Funding needed to complete:
- R&D: $32.3 million
- Procurement: $1,272.0 million
- Total funding: $1,378.4 million
- Procurement quantity: 159

Program Performance (fiscal year 2010 dollars in millions)

	As of 12/2006	Latest 08/2009	Percent change
Research and development cost	$583.3	$633.8	8.7
Procurement cost	$1,641.2	$1,418.0	-13.6
Total program cost	$2,551.1	$2,195.4	-13.9
Program unit cost	$14.413	$12.545	-13.0
Total quantities	177	175	-1.1
Acquisition cycle time (months)	104	119	14.4

The VTUAV program entered low-rate initial production in May 2007 with mature technologies and stable designs. The program uses common, mature technologies; for example, the air vehicles are based on a commercial manned helicopter that has been in service for over 20 years. The VTUAV is currently undergoing developmental and operational testing and has landed successfully aboard a ship. The program plans to achieve initial operational capability in late 2009 and reach a full-rate production decision in March 2010. In February 2008, after being advised of at least a 2-year delay in the Littoral Combat Ship program, the Navy decided to continue VTUAV development using an alternate ship—a frigate. Navy officials estimated the move to the alternate ship would require $42.6 million of additional funding and result in a 9-month schedule delay for the VTUAV program.



VTUAV Fire Scout Program

Technology Maturity

According to the program office, the VTUAV relies on common, mature technologies. In 2006, the program office completed a technology readiness assessment to support the VTUAV's entry in production and concluded that it had no critical technologies because it utilized existing commercial technologies. For example, the air vehicles are based on a commercial manned helicopter that has been in service for over 20 years. The VTUAV has landed successfully aboard a Navy frigate and has demonstrated operational capability. The operational test community's formal evaluation of the system's operational suitability and effectiveness is scheduled to be completed by December 2009. Operational evaluation was delayed to incorporate software changes that should reduce the number of erroneous warnings displayed to the operator and to improve system reliability.

Design Maturity

The VTUAV's design is stable and the program has released over 99 percent of the system's drawings. However, the program did not achieve design stability until it reached low-rate initial production in May 2007—18 months after its November 2005 design review. According to the program office, the design changes that have been made since then involve final updates to the avionics and ground control station needed to field the system safely or to account for reconfiguration of the ground control station to deploy on a frigate versus the Littoral Combat Ship.

Production Maturity

The VTUAV was originally designed as a modified commercial off-the-shelf item. We could not assess production maturity because the program did not require Northrop Grumman—the prime contractor—or its supplier base to identify key product characteristics, which is the first step to implementing production process controls. One VTUAV supplier does use statistical process controls to measure elements of blade manufacturing. The program has conducted numerous production readiness assessments of Northrop Grumman and its key suppliers and determined that the program needs to identify key product characteristics across the program. In addition, the program will collect statistical process control data as part of the production contract. The program plans to procure nine aircraft during low-rate initial production.

Other Program Issues

In February 2008, after being advised of at least a 2-year delay in the LCS program, the Navy decided to continue VTUAV development using an alternate ship—a frigate. Navy officials estimated the move to the alternate ship would require $42.6 million of additional funding and result in a 9-month schedule delay for the VTUAV program. The additional funds were used to determine the system changes that would be needed to deploy the VTUAV off a frigate, including the mechanical integration of the system into the ship and changes in the ground control station.

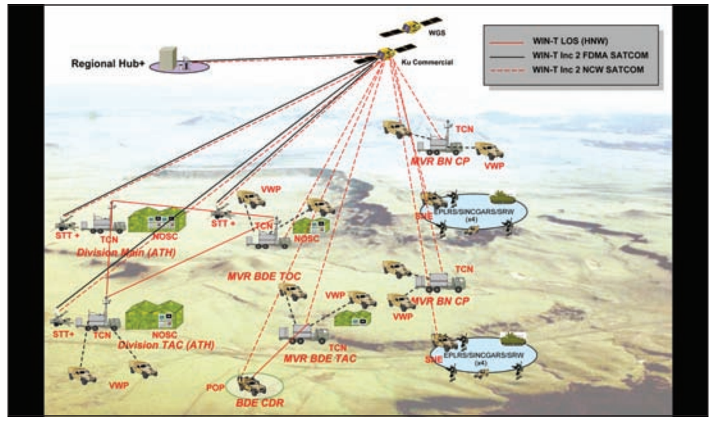
The VTUAV program is currently considering a variety of future capabilities that could be added to the system, including a surface search radar, a signals intelligence package, an enhanced data and communications relay, and weapons. The program office has funding and plans in place to integrate a surface search radar in fiscal year 2010. Other capabilities are currently unfunded. Work on these capabilities will not begin until at least fiscal year 2012.

Program Office Comments

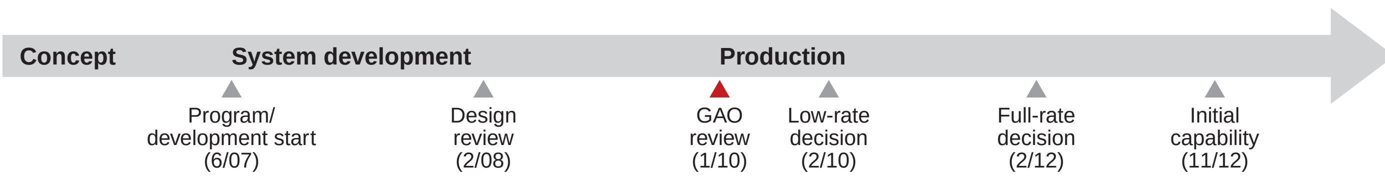
The program office concurred with the draft of this assessment.

Warfighter Information Network-Tactical Increment 2

WIN-T is the Army's high-speed and high-capacity backbone communications network. WIN-T connects Army units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a Nunn-McCurdy unit cost breach of the critical threshold, and will be fielded in four increments. The second increment will provide the Army with an initial networking on-the-move capability.



Source: Office of the Project Manager WIN-T.



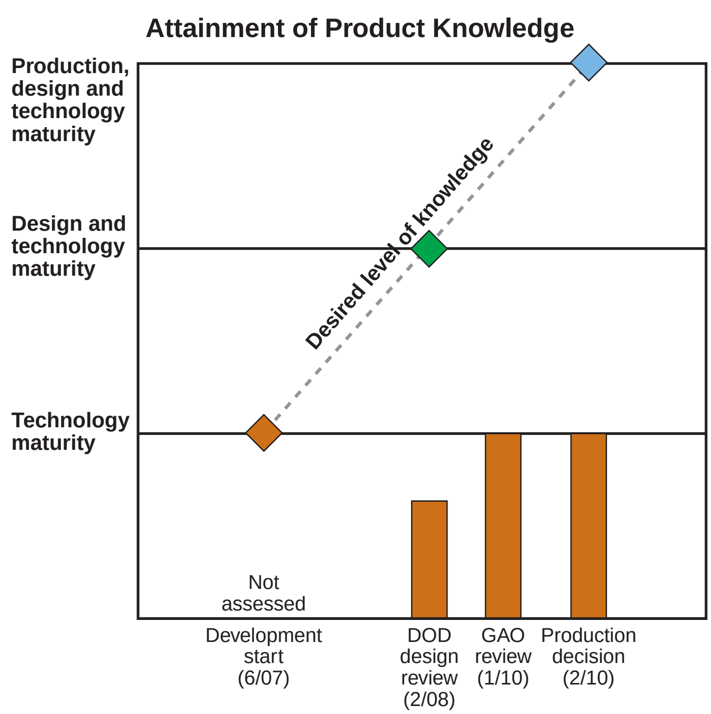
Program Essentials

Prime contractor: General Dynamics C4 Systems Corp.
Program office: Ft. Monmouth, NJ
Funding needed to complete:
- R&D: $28.9 million
- Procurement: $3,093.2 million
- Total funding: $3,122.1 million
- Procurement quantity: 1,635

Program Performance (fiscal year 2010 dollars in millions)

	As of 10/2007	Latest 02/2010	Percent change
Research and development cost	$232.7	$239.7	3.0
Procurement cost	$3,384.5	$3,227.2	-4.6
Total program cost	$3,617.2	$3,466.9	-4.2
Program unit cost	$1.911	$1.984	3.9
Total quantities	1,893	1,747	-7.7
Acquisition cycle time (months)	50	65	30.0

All 15 WIN-T Increment 2 critical technologies were mature by its planned January 2010 production decision. In November 2009, the Director, Defense Research and Engineering, concurred with an Army assessment that found all WIN-T Increment 2 critical technologies had been demonstrated in a realistic environment. When WIN-T Increment 2 began development in June 2007, only seven critical technologies were mature or nearing maturity. The other eight technologies could not be assessed because the Army did not provide sufficient evidence of their maturity. We could not assess the design stability or production maturity of WIN-T Increment 2 because the program office does not track the number of releasable drawings or critical manufacturing processes in statistical control. According to the program office, these metrics are not meaningful because WIN-T is not a manufacturing effort.



WIN-T Inc 2 Program

Technology Maturity

All 15 WIN-T Increment 2 critical technologies were mature by its planned January 2010 production decision. In September 2009, the Army completed a technology readiness assessment to support a low-rate initial production decision. An independent review team reviewed this technology readiness assessment and the body of evidence used to support it and concluded that all 15 critical technologies were mature. In November 2009, the Director, Defense Research and Engineering, concurred with the independent review team's assessment, noting that tests conducted by the Army show that each of WIN-T Increment 2's critical technologies have been demonstrated in a realistic environment.

The original WIN-T program entered system development in August 2003 with only 3 of its 12 critical technologies nearing maturity; none were fully mature. Insufficient technical readiness was cited as one of the key factors leading to a March 2007 Nunn-McCurdy unit cost breach of the critical threshold for the original program. Following that cost breach, the WIN-T program was restructured to be fielded incrementally using more mature technologies. When WIN-T Increment 2 began development in June 2007, only seven critical technologies were mature or nearing maturity. However, the maturity of the other eight WIN-T Increment 2 critical technologies could not be assessed because the Army did not provided sufficient evidence to the Director, Defense Research and Engineering.

Design Maturity

According to program officials, WIN-T Increment 2 completed a successful critical design review in February 2008; however, we could not assess the design stability of the WIN-T Increment 2 because the program office does not track the number of releasable drawings. According to the program office, this metric is not meaningful because WIN-T is not a manufacturing effort. Instead, it measures performance through a series of component, subsystem, configuration item, and network level test events designed to demonstrate performance at increasing levels of system integration.

Production Maturity

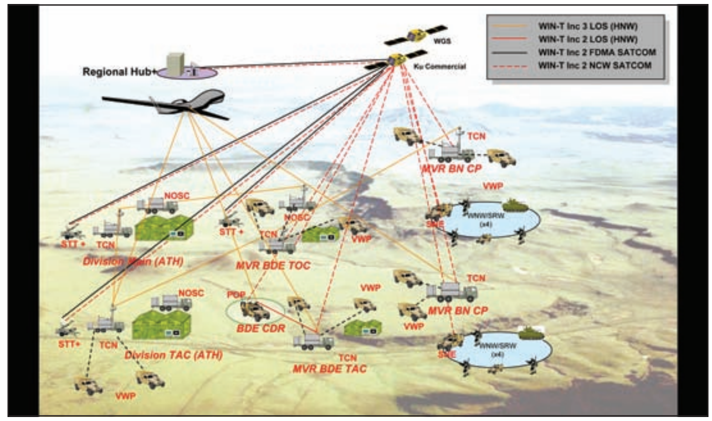
We could not assess the production maturity of the WIN-T Increment 2. According to the program office, WIN-T is primarily an information technology integration effort that relies on commercially available products.

Program Office Comments

In commenting on a draft of this assessment, the Army noted that the program office completed a Limited User Test (LUT) in March 2009 to demonstrate that WIN-T Increment 2 will meet its operational requirements. The LUT is an operational test designed to verify and validate the suitability of the system for operational deployment. The event also provides an opportunity to track training, reliability, and supportability of WIN-T components and system. The test was conducted at Fort Lewis, Washington; Fort Stewart, Georgia; and Fort Gordon, Georgia, and included a Brigade Combat Team and Division slice of Increment 2 equipment. The test also included a representative suite of WIN-T Increment 1 equipment to demonstrate interoperability across the increments. The Army Test and Evaluation Command completed an independent evaluation of the event and generated a report on its findings. The results of this test along with an earlier Developmental Test were used to support a successful Milestone C production decision on February 3, 2010. The Army also provided technical comments, which were incorporated as appropriate.

Warfighter Information Network-Tactical, Increment 3

WIN-T is the Army's high-speed and high-capacity backbone communications network. WIN-T connects Army units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a Nunn-McCurdy unit cost breach of the critical threshold, and will be fielded in four increments. The third increment will provide the Army a full networking on-the-move capability.



Source: Office of the Project Manager WIN-T.

Concept	System development			Production		
	Program/ development start (7/03)	GAO review (1/10)	Design review (2/14)	Low-rate decision (5/16)	Full-rate decision (12/18)	Initial capability (6/19)

Program Essentials

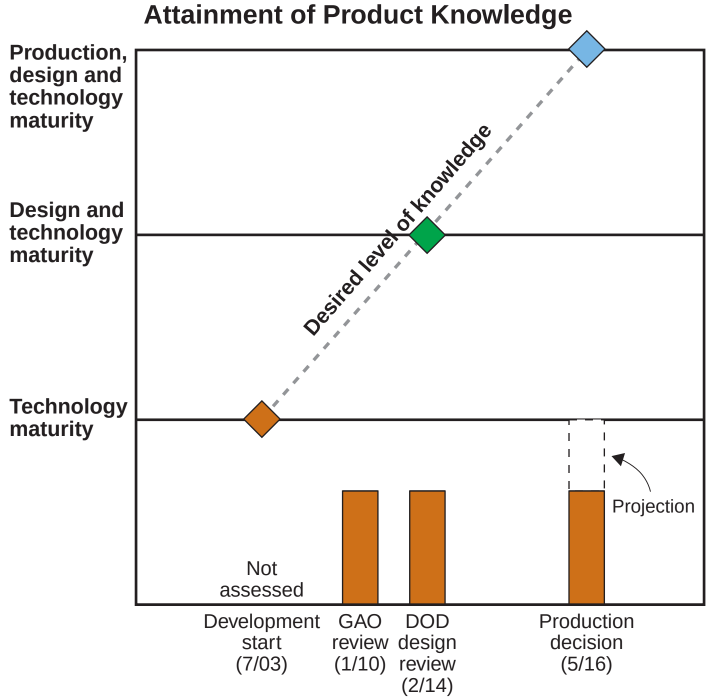
Prime contractor: General Dynamics C4 Systems Corp.
Program office: Ft. Monmouth, NJ
Funding needed to complete:
- R&D: $1,634.5 million
- Procurement: $13,344.5 million
- Total funding: $14,979.0 million
- Procurement quantity: 3,443

Program Performance (fiscal year 2010 dollars in millions)

	As of 05/2009	Latest 02/2010	Percent change
Research and development cost	$2,621.5	$2,621.5	0.0
Procurement cost	$13,344.5	$13,344.5	0.0
Total program cost	$15,966.0	$15,966.0	0.0
Program unit cost	$4.585	$4.585	0.0
Total quantities	3,482	3,482	0.0
Acquisition cycle time (months)	165	191	15.8

According to the program office, all 20 WIN-T Increment 3 critical technologies will not be mature and demonstrated in a realistic environment until its planned May 2013 production decision. Three technologies are currently mature and 15 are nearing maturity. The 19th technology was also rated as nearing maturity by an independent review team; but, the Director, Defense Research and Engineering (DDR&E), concluded that the technology, while robust, had ambiguous requirements that made it difficult to state whether the technology had been adequately demonstrated. The 20th technology—a cryptographic device whose development is being managed by the National Security Agency—is not yet available to be rated. The Army expects to have a revised WIN-T Increment 3 acquisition program baseline in place by March 2010 that accounts for changes to the Future Combat System program.

Attainment of Product Knowledge



WIN-T Inc 3 Program

Technology Maturity

According to the program office, all 20 WIN-T Increment 3 critical technologies will not be mature and demonstrated in a realistic environment until its planned May 2013 production decision. In April 2009, the Director, Defense Research and Engineering (DDR&E), reviewed an Army technology readiness assessment and concluded that 3 WIN-T Increment 3 critical technologies were mature and 15 were nearing maturity.

The 19th technology—the Quality of Service Edge Device (QED)—was rated as nearing maturity in the Army assessment; however, DDR&E concluded that this technology had ambiguous requirements that made it difficult to state whether it had been adequately demonstrated. DDR&E noted that while the Army had demonstrated that the QED technology met requirements under most conditions, in one stressing scenario it did not. DDR&E representatives believe that it is unlikely that any network can meet this requirement in all environments. Since the QED technology was shown to be robust and capable of meeting its requirement in most scenarios, DDR&E recommended that the Army clarify the user's requirements for this technology by the next design review, currently scheduled for November 2011.

The 20th technology—High Assurance Internet Protocol Encryptor (HAIPE) version 3.X—was not available to be rated. HAIPE is a device that encrypts and encapsulates Internet protocol packets so that they can be securely transported over a network of a different security classification. The current version of HAIPE (version 1.3.5) is mature; however its use in WIN-T Increment 3 would result in a less efficient network design. DDR&E has notified the Army that the maturity of the HAIPE version 3.X technology should be established to DDR&E's satisfaction before it is transitioned into WIN-T Increment 3. The National Security Agency (NSA) manages the HAIPE program and is responsible for certifying the maturity of HAIPE technology. According to an NSA representative, NSA has not yet been formally tasked with providing an assessment of HAIPE 3.X. However, the official believes that the latest version of HAIPE—version 3.1.2—is nearing maturity.

Other Program Issues

The Defense Authorization Act for fiscal year 2009 restricted the WIN-T Increment 3 program's ability to obligate and expend research, development, test, and evaluation funding for fiscal year 2009 until the Under Secretary of Defense for Acquisition, Technology and Logistics notified congressional defense committees that a new acquisition program baseline had been approved and an independent cost estimate and technology readiness assessment had been completed. In May 2009, the Under Secretary notified the congressional defense committees that these actions had been completed. However, the new baseline was developed prior to the Secretary of Defense's recommended cancellation of portions of the Future Combat System (FCS) program, which is closely related to WIN-T Increment 3. As a result, the Under Secretary restricted the Army from obligating or expending WIN-T Increment 3 funds associated directly with FCS and directed that a new cost estimate and acquisition program baseline be completed and approved. According to an Army representative, a new baseline will be in place by March 2010.

Program Office Comments

In commenting on a draft of this assessment, the Army noted that the program office received notification of the cancellation of the manned ground vehicle component of the Future Combat System program. The Department of Defense Defense Acquisition Executive issued an Acquisition Decision Memorandum in May 2009 that directed WIN-T to refocus its efforts on Transmission Sub-System in supporting the airborne communications relay and WIN-T Increment 2. The Army also provided technical comments, which were incorporated as appropriate.

Air and Missile Defense Radar (AMDR)

The Navy's Air and Missile Defense Radar (AMDR) will be a next-generation radar system designed to provide ballistic missile defense, air defense, and surface warfare capabilities. The Navy plans to develop AMDR with technology that is scalable and adaptable to changes in future operational requirements. The Navy is designing AMDR to support multiple ship classes.

Source: PEO IWS.

Current Status

The AMDR program began concept development in 2009. In June 2009, the Navy awarded fixed-price concept development contracts to Northrop Grumman, Lockheed Martin, and Raytheon. Each contractor completed concept studies and developed a plan for demonstrating the program's four key critical technologies in a relevant environment prior to engineering and manufacturing development. Program officials stated that these concept studies contracts were completed in December 2009. According to program officials, the digital beamforming—a critical technology necessary for AMDR's simultaneous air defense and ballistic missile defense mission—will likely take the longest time in development to mature. Program officials stated that this technology is currently in use on existing radars, but has not been demonstrated on a large-aperture radar.

In December 2009, the Navy released a request for proposals for AMDR technology development pending the completion of a Navy-sponsored study of possible hulls and radar specifications for the Navy's future surface combatant. By the third quarter 2010, program officials expect to receive approval to enter technology development and award up to three technology development contracts. As required under the new acquisition policy, AMDR's technology development phase will include the development of competitive prototypes.

While the Navy plans to install AMDR on future platforms, the Navy estimates that AMDR will not be available for delivery to a shipyard until fiscal year 2019.

Funding, Fiscal Year 2010: RDT&E $189.1 million

Next Major Program Event: Technology development start, fiscal year 2010

Program Office Comments: The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

B-2 Spirit Advanced Extremely High Frequency (EHF) SATCOM Capability Increment 2

The Air Force's B-2 EHF SATCOM is a satellite communication system designed to upgrade the current avionics infrastructure, replace the ultra high frequency system, and ensure a continued secure, survivable communication capability. The program includes three increments. Increment 2 provides survivable strategic connectivity by adding low-observable antennas and radomes, and includes nonintegrated Family of Advanced Beyond Line-of-sight Terminals (FAB-T) and related hardware.

Source: B-2 Systems Group 1999, USAF photo.

Current Status

In March 2008, the B-2 EHF Increment 2 program initiated a two-phase component advanced development effort to conduct detailed systems engineering, requirements analysis, technology maturation, and preliminary design activities prior to the start of engineering and manufacturing development (EMD). During the first phase, the program identified risks that raised concerns about the viability of existing Increment 2 requirements. Specifically, the program determined that three out of four key performance parameters could not be met as written; no technology could meet all the requirements; requirements did not adequately reflect warfighter needs and available technologies; and the current need date for providing Increment 2 capabilities could not be met. The program reconciled these problems with user requirements and technical capabilities in October 2009. The program expects to shift away from a mechanical array to an active electronically scanned array (AESA) radar. According to program officials, this change should mitigate several program risks by removing limitations on where the array can be installed on the aircraft and enabling the aircraft to manage transmission power. However, the effect that radar integration will have on the low-observable characteristics, as well as antenna technology maturation and FAB-T integration, remain risk items for the program.

The B-2 EHF program recently decided to delay the planned start of EMD for Increment 2 by over a year. This decision, as well as the one to conduct extensive technical studies and requirements analysis prior to preliminary design and EMD, should help mitigate future program risks and decrease the likelihood of late, and potentially more costly, changes to requirements. The program office is developing new cost and schedule estimates that will reflect revisions to the program's requirements and technical approach. The new cost estimate is expected in early 2010.

Estimated Program Cost: $1,394.5 million. The program office cost estimate is from 2008. It is currently being revised and is expected to increase.

Next Major Program Event: Engineering and manufacturing development start, January 2012

Program Office Comments: The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

BMDS Space Tracking and Surveillance System (STSS)

MDA's STSS is designed to acquire and track threat ballistic missiles in all stages of flight. The agency obtained the two demonstrator satellites in 2002 from the Air Force SBIRS Low program that halted in 1999. The MDA refurbished and launched the two STSS demonstrations satellites on September 25, 2009. Over the next 2 years, the two satellites will take part in a series of tests to demonstrate their functionality and interoperability with the Ballistic Missile Defense System (BMDS).

Source: Photo courtesy of Northrop Grumman Space Technology.

Current Status

In September 2009, two STSS demonstration satellites were successfully placed on-orbit. According to the program office, the 2 years of launch delays resulted in over $400 million in cost growth. Specifically, STSS officials reported that contract costs increased by 40 percent or $385 million, including about $115 million to address the various hardware issues that drove the launch delays. In addition, they estimated that vehicle integration and launch support payments to NASA increased from $78 million to nearly $100 million.

MDA expects to gain valuable information from the STSS demonstration. The program plans to test STSS capabilities, including missile detection and tracking throughout all phases of flight and intercept assessment in the context of the BMDS. According to the STSS program office, lessons learned from the STSS satellites will inform the design of a Precision Tracking Space System (PTSS) experimental prototype, scheduled to launch in 2014. The PTSS will be a new technology development program, separate from STSS, which will apply lessons learned from the STSS demonstration and its own prototype to make decisions regarding a future satellite constellation.

While the STSS program sustained personnel cuts, creating a knowledge and expertise gap, program officials reported they have filled most open positions and that the Air Force has committed to fully staffing the program. According to the program office, maintaining these personnel levels is important for ensuring that all the analysis and data collection functions are resourced. The STSS program also incurred significant funding cuts in fiscal year 2009 and anticipates additional cuts in fiscal year 2010. Although program officials explained that they were able to maintain continuous, around-the-clock satellite operations, they reduced STSS software upgrade development efforts and system engineering support, and terminated all technology risk-reduction efforts. According to the program office these cuts may delay the achievement of several STSS BMDS-level interoperability objectives.

Funding, Fiscal Years 2010-2013: RDT&E $472 million

Next Major Program Event: NA

Program Office Comments: The program office stated that STSS will provide risk-reduction data collection for future space-based sensor development, provide the necessary data to validate MDA space sensor models and simulations, and support functional demonstrations of the future operational integrated space architecture. The program also provided technical comments, which were incorporated as appropriate.

C-27J

The Air Force's C-27J Spartan is a mid-range, multifunctional aircraft. Its primary mission is to provide on-demand transport of time-sensitive, mission-critical supplies and key personnel to forward-deployed Army units, including those in remote and austere locations. Its mission also includes casualty evacuation, airdrop, troop transport, aerial sustainment, and homeland security. The aircraft is capable of carrying up-armored High Mobility Multipurpose Wheeled Vehicles and heavy, dense loads such as aircraft engines and ammunition.

Source: L-3 Communications.

Current Status

Initially designated the Joint Cargo Aircraft, the C-27J program began in late 2005 when the Under Secretary (Acquisition, Technology and Logistics) directed the Army and Air Force to merge their intratheater airlift requirements. In June 2007, a joint Army / Air Force source selection team selected the commercial-off-the-shelf C-27J as the Joint Cargo Aircraft in a full and open competition, and awarded a firm-fixed price contract to L-3 Communications Integrated Systems. The program entered DOD's acquisition cycle at Milestone C (low-rate initial production) since it involved the procurement of a commercial aircraft.

In fiscal year 2009, a DOD Resource Management Decision transferred responsibility for the program and the Army's time-sensitive / mission-critical resupply mission to the Air Force. As part of this restructuring, planned program quantities were reduced by approximately 51 percent, from 78 to 38 aircraft. Army orders constitute 13 of the 38 aircraft. These aircraft—2 of which have already been delivered—will be transferred to the Air Force. Air Force procurements under the program are expected to end in fiscal year 2012. The services have developed an event-driven plan to transition programmatic and functional responsibilities, such as contracting, engineering, and logistics, to the Air Force throughout fiscal year 2010. Additionally, the Army and Air Force have drafted a concept of employment describing how they will operate together providing tactical airlift for the Army to transport time-sensitive, mission-critical equipment, supplies, and personnel.

Funding, Fiscal Years 2006-2015:
RDT&E: $118.5 million
Procurement: $1,705.3 million
Quantity: 38

Next Major Program Event: Initial operational capability, November 2010

Program Office Comments: The program office concurred with this assessment and provided technical comments, which were incorporated where appropriate.

Common Infrared Countermeasures (CIRCM)

The Army's CIRCM will be used with the Common Missile Warning System, and a countermeasure dispenser capable of loading and employing expendables, such as flares and chaff, to defend U.S. aircraft from advanced infrared-guided missiles. CIRCM is one of three subprograms that make up the Advanced Threat Infrared Counter Measures/Common Missile Warning System (ATIRCM / CMWS) major defense acquisition program. CIRCM will provide development of laser-based countermeasure systems for all rotary-wing and tilt-rotor aircraft across DOD.

Source: BAE Systems.

Note: Photo is of the ATIRCM/CMWS.

Current Status

In June 2009 the Army received approval to award contracts to five contractors to provide systems for testing. According to a program official, these tests are complete and are being used to determine the performance and maturity of the competing systems. The Army has conducted a system-level preliminary design review for the CIRCM program. According to DOD, these contracts will five satisfy the requirement for competitive prototyping prior to the planned start of engineering and manufacturing development. According to a program official, the results of the Army competitive testing will be presented to Army and OSD leadership in February 2010 to discuss the acquisition path forward. The EMD contract award date will be determined after the Army and OSD's overarching integrated product teams meet—scheduled for February 2010.

The CIRCM program began when the Under Secretary of Defense for Acquisition, Technology and Logistics supported the Army's decision to restructure the ATIRCM/CMWS program and directed the Army to establish subprograms in April 2009. The Under Secretary determined that aircraft survivability equipment development needed better coordination of service efforts, more emphasis on competitive prototyping, and a greater focus on reducing ownership cost by increasing reliability. The Under Secretary allowed CMWS to remain in full-rate production, but limited ATIRCM to fielding an interim laser jammer capability for CH-47 helicopters in use in Afghanistan and Iraq. This interim laser jammer capability will satisfy a Quick Reaction Capability need approved by the Army in September 2008. According to a program official, the ATIRCM first unit equipped was scheduled for September 2009; however, it was delayed until November 2009 to allow for testing with representative units prior to fielding.

Funding, Fiscal Years 2009-2010: RDT&E $238.820 million for ATIRCM, CMWS, and CIRCM

Next Major Program Event: Technology Development start, TBD

Program Office Comments: In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated where appropriate.

F-22A Raptor

The Air Force's F-22A, originally planned to be an air superiority fighter, will have an expanded air-to-ground attack capability. It was designed with advanced features, such as stealth characteristics and supercruise, to make it less detectable and capable of higher speeds. The Air Force established the F-22A modernization and improvement program in 2003 to add enhanced air-to-ground, information warfare, reconnaissance, and other capabilities and to improve the reliability and maintainability of the aircraft.

Source: U.S. Air Force, http://www.af.mil/photos/index.asp?galleryID=40&page=5.

Current Status

In April 2009, the Secretary of Defense announced that F-22A production would end at 187 aircraft. The Air Force has accepted delivery of 154 aircraft. The total cost to shutdown the F-22A production line has not been determined.

As currently planned, the F-22A will be delivered in three configurations—global strike initial enhanced, global strike basic, and ground global strike enhanced. The Air Force originally planned to complete development of enhanced F-22A capabilities in 2010. Due to schedule delays, funding cuts, and requirement changes, the schedule has slipped 3 years. The Air Force has fielded and flight tested the first of four planned increments of the modernization program. The second major increment (3.1) is currently undergoing flight testing and is scheduled to start follow-on test and evaluation in 2010. One of the major capabilities included in increment 3.1 is the APG-77 Synthetic Aperture Radar (SAR). The SAR radar is critical to giving the F-22A the ability to identify and target enemy ground defenses. The Air Force has only tested this radar on a flying test bed aircraft. The SAR radar will not be operationally tested on the F-22A aircraft until late 2010. The third increment of the modernization program (3.2) is currently in the requirements and analysis phase. During this phase, three new requirements were added to increment 3.2—the multi-functional advanced data link, electronic protection, and combat identification. The critical technologies that support these requirements are not mature and prototypes have yet to be demonstrated in a relevant environment. In total, the program has obligated over $3 billion for the F-22 modernization and reliability improvement program.

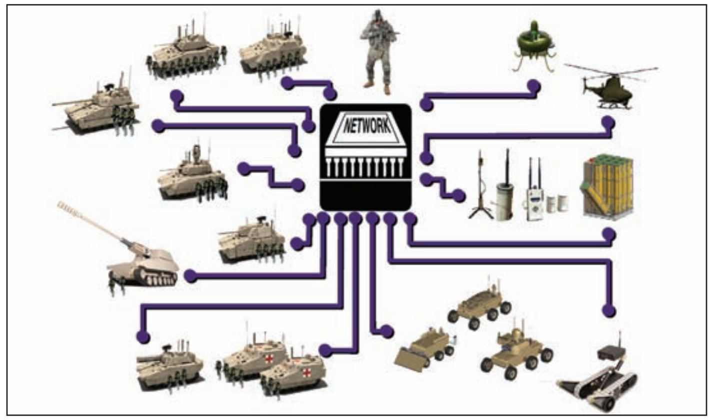
Funding, Fiscal Years 2010-2013: RDT&E $1,674.5 million; Procurement $1,051.1 million

Next Major Program Event: Initiation of follow-on test and evaluation for increment 3.1, 2010

Program Office Comments: The F-22A program office provided technical comments on a draft of this assessment, which were incorporated as appropriate.

Future Combat System (FCS)

Until it was significantly restructured, the Army's FCS was the centerpiece of Army plans to transition to a lighter, more agile, and more capable combat force. The FCS program consisted of an integrated family of advanced, networked combat and sustainment systems; unmanned ground and air systems; and unattended sensors and munitions. FCS featured 14 major systems and other enabling systems along with an overarching network for information superiority and survivability.



Source: U.S. Army.

Current Status

In April 2009, the Secretary of Defense announced plans to significantly restructure the FCS Brigade Combat Team (BCT) acquisition program. In the restructure, the Army terminated the manned ground vehicle development and abandoned its plans to field separate FCS BCTs. In a statement explaining his decision, the Secretary noted that the FCS vehicles did not adequately reflect the lessons of counterinsurgency and close-quarters combat in Iraq and Afghanistan. Furthermore, he stated that he was troubled by the terms of the FCS contract, in particular its very unattractive fee structure that gave the government little leverage to promote cost efficiency. At this time, the costs to terminate vehicle development are unknown. The Army is also negotiating the content and terms for the revised contract to develop the remaining items from the FCS program. The Office of Management and Budget estimates that net savings from terminating the ground vehicles, even after a replacement program has begun, could be $22.9 billion through fiscal year 2015.

In June 2009, the Under Secretary of Defense for Acquisition, Technology and Logistics signed an acquisition decision memorandum that instructed the Army to transition to a modernization plan consisting of a number of integrated acquisition programs: one to produce and field the first seven infantry BCT unit sets; one or more acquisition programs to include, but not limited to, follow-on BCT modernization to develop, produce, and field required unmanned systems, sensors, and networking for the remaining combat brigades; one to continue development and fielding of incremental ground tactical network capability; and one to develop ground combat vehicles. The Army established a task force to carry out some of those instructions and that task force has generated, among other things, the preliminary requirements for the ground combat vehicle.

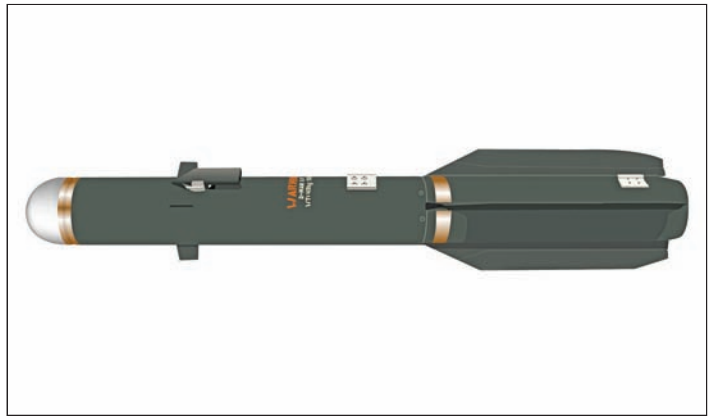
Funding, Fiscal Years 2009-2013: TBD

Next Major Program Event: In February 2010, DOD expected to make a materiel development decision for the ground combat vehicle program and the Army is proceeding with plans to conduct an analysis of alternatives.

Program Office Comments: The program office provided technical comments, which were incorporated into this product.

Joint Air-to-Ground Missile

JAGM is an Army-led joint program between the Army, Navy, and Marine Corps. The missile will be air-launched from helicopters and fixed-wing aircraft and is designed to target tanks; light armored vehicles; missile launchers; command, control, and communications vehicles; bunkers; and buildings. It is expected to provide line-of-sight and beyond line-of sight capabilities and be employed in a fire-and-forget mode or a precision attack mode. The missile will replace Hellfire, Maverick, and air-launched TOW missiles.



Source: JAMS Project Office.

Current Status

JAGM was approved to start a 27-month technology development phase in September 2008, and the program is implementing DOD's policy on competitive prototyping. The Army awarded fixed-price incentive contracts to Lockheed Martin and Raytheon for the technology development effort, which will culminate with flight tests of competing prototypes. The Army will select one of the contractors to proceed to engineering and manufacturing development. The JAGM program also plans to conduct a preliminary design review in the third quarter of fiscal year 2010. The program must also complete a postpreliminary design review assessment before it can be certified to enter engineering and manufacturing development.

The JAGM program has identified three critical technologies—a multimode seeker for increased countermeasure resistance, boost-sustain propulsion for increased standoff range, and a multipurpose warhead for increased lethality. Program officials noted that many of the components of these technologies are being used on other missile systems, but they have not been fully integrated into a production missile. Program officials expect these technologies to be nearing maturity by the start of system development. To mitigate potential schedule and funding risks, the program has identified backup technologies for integration that are almost all mature. However, according to the program office, use of these backups could result in reduced capability, with the possibility of higher development and production costs, or an increased logistics burden or both.

The Army will continue to extend the fielding of Hellfire missiles to meet the needs of the warfighter, while the Navy will rely on both Maverick and Hellfire missiles until JAGM becomes available.

Estimated Total Program Cost, Fiscal Years 2008-2027: $6,385.8 million

RDT&E: $1,642.2 million

Procurement: $4,743.6 million

Quantities: 33,853

Next Major Program Event: Milestone B decision, November 2010. Engineering and Manufacturing development start, December 2010.

Program Office Comments: The program office made technical corrections, which were incorporated as appropriate. It noted that funding numbers are program office estimates and will be updated by the Director, Cost Assessment and Program Evaluation, at the Milestone B decision.

Joint Light Tactical Vehicle (JLTV)

The U.S. Army, Marine Corps, and Special Operations Command's Joint Light Tactical Vehicle concept is a family of vehicles that is intended to supplement and potentially replace the High-Mobility Multi-Purpose Wheeled Vehicle. The JLTV plans to provide defensive measures covering troops while in transport, increase payload, improve the logistics footprint, and reduce soldier workload associated with system operation and field maintenance activities. JLTV also expects to reduce life cycle costs through commonality at the subassembly and component level.

Source: PM JLTV/TD Phase Industry models as of 29 Oct 2009.

Current Status

In December 2007, the Undersecretary of Defense for Acquisition, Technology and Logistics directed the Army to begin a 27-month technology development phase for the JLTV program with the goal of reducing risks prior to and shortening the length of system development. As part of the technology development phase, the JLTV program is implementing DOD's policy to develop competitive prototypes, demonstrate critical technologies in a relevant environment, and conduct a preliminary design review before entering into engineering and manufacturing development. In October 2008, the Army awarded technology development contracts to BAE Systems Land & Armaments, Ground Systems Division; General Tactical Vehicles, a joint venture of General Dynamics Land Systems and AM General; and Lockheed Martin Systems Integration. The Army plans to prototype and test 4 of the 10 configurations of JLTV during the technology development phase. In addition, each contractor will complete designs for the entire family of vehicles. The JLTV program completed preliminary design reviews during the summer of 2009. Critical design reviews are planned for early fiscal year 2010.

At the conclusion of the technology development phase, the Army plans to hold a full and open competition and award two engineering and manufacturing development contracts. Following development, one of these two contractors will be selected for the production phase. If approved by the milestone decision authority, the program could begin low-rate initial production on selected JLTV configurations immediately following the technology development phase.

Funding, Fiscal Years 2008-2010: RDT&E $306.68 million (Army—$163.44 million; USMC—$143.24 million)

Next Major Program Event: Engineering and manufacturing development start, fourth quarter fiscal year 2011

Program Office Comments: In commenting on a draft of this assessment, program officials stated that JLTV will restore transportability and overcome the current imbalance in protection, payload, and performance found in the existing tactical vehicle fleet. Modernizing the tactical vehicle fleet with JLTV is necessary to provide protected, sustained, and networked mobility for Army and Marine Corps personnel and equipment on the battlefield.

Kiowa Warrior (KW)

The Army's OH-58D Kiowa Warrior is a two-seat, single-engine, observation, scout/attack helicopter. The helicopter operates autonomously at standoff ranges providing armed reconnaissance, command and control, and target acquisition for other airborne weapons platforms in day, night, and adverse-weather conditions. We assessed the cockpit and sensor upgrade program that is part of a larger modification effort designed to extend the life of the Kiowa Warrior and address issues with interoperability, survivability, and sustainability.

Source: Kiowa Warrior ASH PMO.

Current Status

The Kiowa Warrior Cockpit and Sensor Upgrade program is part of an ongoing Operational Service Extension Program designed to extend the life of the fleet through 2025. The Army approved the program's entry into the technology development phase in May 2009 in preparation for a development start decision in the fourth quarter of 2010. The program includes upgrades to improve the cockpit, performance, reliability, sustainability, survivability, communications, and lethality of the helicopter. For example, improvements to the cockpit include an improved master control processor, color displays, and independent mapping channels. The Army plans to upgrade the cockpit and sensors for the entire fleet of 368 Kiowa Warriors.

The Kiowa Warrior Cockpit and Sensor Upgrade program has identified 10 critical technologies and is working to mature these technologies prior to the start of system development in the fourth quarter of 2010. Preliminary internal Army analysis indicate that all critical technologies may not be mature by the development decision, which puts the program at risk for cost growth and schedule delays. DOD regulations require that all critical technologies be demonstrated in a relevant environment prior to the start of system development. The Army has identified backup technologies for some but not all of the identified critical technologies and is addressing all critical technologies as part of its overall Technology Development Strategy.

Funding, Fiscal Years 2010-2014: RDT&E $732.3 million.

Next Major Program Event: System development start, fourth quarter 2010

Program Office Comments: A technology readiness assessment will be contained in the Acquisition Strategy Report not available until after Milestone B is completed (4Q10). A cursory, program-internal analysis did not adhere to strict guidelines expected by the DOD Technology Readiness Assessment Guidebook (May 2005) and did not include key inputs from industry and government sources.

Next Generation GPS Control Segment (OCX)

The Air Force's next generation GPS control segment (OCX) will provide command, control, and mission support for the GPS Block II and III satellites. OCX is expected to assure reliable and secure delivery of position and timing signals to serve the evolving needs of GPS military and civilian users. The Air Force plans to develop OCX in four blocks using an incremental approach to deliver upgrades as they become available. The first block will provide mission operations for GPS Block II and Block III satellites.

Source: GPSW OCS Program Office.

Current Status

The GPS OCX program is in the technology development phase. In November 2007, the Air Force awarded contracts to Raytheon and Northrop Grumman for concept development, including prototyping activities. In February 2009, these contracts were modified to include further risk-reduction activities. DOD was originally scheduled to review the GPS OCX program for entry into the engineering and manufacturing development phase in April 2009; however, according to program officials, that review has been rescheduled for the fall of 2010 to allow the program to hold a preliminary design review, which is now statutorily required to be held before a program enters the engineering and manufacturing development phase. According to the program office, the GPS OCX's 14 critical technologies are mature—another requirement for entry into engineering and manufacturing development.

To increase confidence in the schedule for delivering OCX, the GPS Wing added 16 months of development time to the effort, which means that OCX would not be fielded in time for the May 2014 launch of the first GPS IIIA satellite. As currently planned, OCX is scheduled to be delivered in August 2015. To address this issue, the GPS Wing is considering funding a parallel effort to command and control the GPS IIIA satellites in case OCX is delivered late. However, the GPS Wing currently predicts that the GPS IIIA satellite launches could begin as late as May 2016 without disrupting GPS service.

There are several areas that pose risks for the program and could affect the schedule, including information assurance certification and space and ground segment integration.

The Air Force's fiscal year 2010 OCX budget request totaled over $389.7 million for activities that include engineering studies and analyses, architecture engineering studies, trade studies, technology needs forecasting, systems engineering, systems development, and test and evaluation efforts.

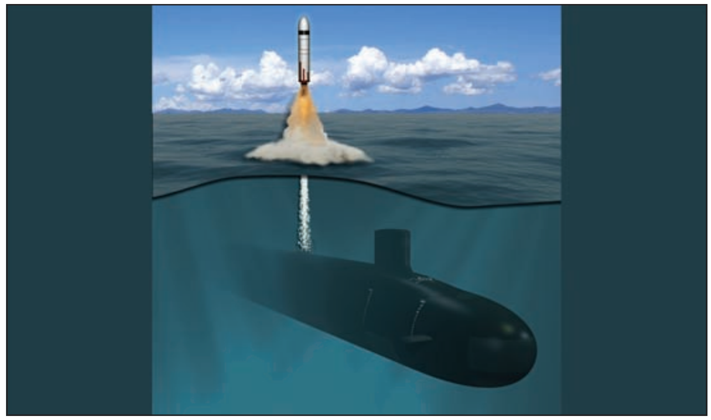
Funding, Fiscal Years 2010-2015: RDT&E $1,526.3 million, Procurement $115.6 million

Next Major Program Event: Engineering and manufacturing development start, fall 2010

Program Office Comments: According to the GPS Wing, OCX will also provide control of new modernized signals for civil users (including safety-of-life applications), secure military signals, and the ability to control signal power to counter enemy jamming threats. Risks associated with information assurance certification and space and ground segment integration are considered normal activities and are addressed as part of the GPS Wing's baseline process.

Ohio-Class Replacement / Sea Based Strategic Deterrent (SBSD)

The Navy's Ohio-class Replacement will replace Ohio-class Ballistic Missile Submarines (SSBN) as they begin to retire in 2027. The Navy began research and development for the future submarine in order to avoid a gap in the provision of sea-based nuclear deterrence between Ohio-class retirement and production of a replacement. The Navy is working jointly with the United Kingdom to develop a common missile compartment for installation on both the Ohio-class Replacement and the United Kingdom's replacement for the Vanguard SSBN.



Source: General Dynamics Electric Boat.

Current Status

The Ohio-class Replacement program is conducting activities leading to entry into the technology development phase in the third quarter of fiscal year 2010. The Joint Requirements Oversight Council approved the Initial Capabilities Document for a Sea Based Strategic Deterrent (SBSD) in June 2008. The Navy recently completed an analysis of alternatives to study potential ship forms and configurations to inform how to best fulfill mission requirements. The Navy is planning for departmental approval of its proposed alternative by the third quarter of fiscal year 2010. According to program officials, the Navy began concept design in fiscal year 2010 to support construction beginning in fiscal year 2019. The Navy Fiscal Year 2009 Long Range Shipbuilding Plan includes 12 Ohio-class Replacement SSBNs.

According to the Navy, in February 2008, the United States and United Kingdom began a joint effort to design a common missile compartment. This effort includes the participation of government officials from both countries, as well as industry officials from Electric Boat Corporation and BAE Systems. To date, the United Kingdom has provided a larger share of funding for this effort, totaling just over $200 million in fiscal years 2008 and 2009. Navy officials told us that Congress approved $495 million for the program in fiscal year 2010. The majority of this funding will support the design of the missile compartment, while about $100 million supports design and feasibility studies for a new reactor plant.

Funding: $13.2 million in fiscal year 2009, $495 million in fiscal year 2010

Next Major Program Event: Entry into the technology development phase in FY 2010

Program Office Comments: The Ohio-class Replacement Program Office generally concurs with the GAO assessment. Efforts to date have focused on development of a common missile compartment for use in the Ohio-class Replacement SSBN and the UK's successor to the existing Vanguard SSBNs.

Third Generation Infrared Surveillance (3GIRS)

The Air Force's Third Generation Infrared Surveillance (3GIRS) is focusing on developing wide field of view (WFOV) earth staring capabilities, including WFOV infrared sensors and algorithms, for space-based infrared surveillance systems. The WFOV technology features a full-earth continuous staring sensor that is expected to enable the use of a smaller, lighter, and simpler payload and improve missile detection and warning times for future missile warning systems.

Source: 3GIRS Program Office.

Current Status

The 3GIRS program is currently developing technologies and has not identified a potential preliminary design start date. The program has taken steps to develop key product knowledge including contracting for competitive prototypes and conducting early subsystem testing. Two sensor prototypes have been delivered, a ground algorithm development laboratory has been established, and a quarter-earth staring sensor payload is scheduled to be delivered in April 2010. This payload—the commercially hosted infrared payload—is expected to be flown and tested on a commercial satellite in the second quarter of fiscal year 2011. According to program officials, two of the program's four critical technologies are currently mature and two are immature having only been tested in a lab environment.

3GIRS began in 2006 as the Alternative Infrared Satellite System. DOD expected the program to serve as a potential alternative to the third SBIRS geosynchronous earth orbit satellite. In August 2007, the milestone decision authority determined the SBIRS program had made substantial progress and directed the now 3GIRS program to refocus its efforts on technology maturation and risk reduction for the next generation of space-based infrared systems. The 3GIRS program had been on a path towards becoming a major defense acquisition program but the Air Force is now focusing 3GIRS on technology maturation for augmentation to the Space-Based Infrared System (SBIRS) and future missile warning systems. 3GIRS officials stated that the Air Force is currently working to identify critical issues, such as needed capabilities, and may conduct an analysis of alternatives this summer. Decisions in these areas can heavily influence total system life cycle costs.

Funding, Fiscal Years 2010-2012: RDT&E $107.6 million

Next Major Program Event: Launch of commercially hosted infrared payload in 2011

Program office comments: In commenting on a draft of this report, the Air Force noted that fiscal year 2011 funding for 3GIRS as a stand alone effort was not requested. Instead, some work will continue under the SBIRS program. The Air Force also provided technical comments, which were incorporated as appropriate.

Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. The comments are reprinted in appendix II. In those comments, DOD stated it was encouraged that the report cited the progress made by DOD in improving its acquisition programs and processes and agreed that factors we highlight, such as early systems engineering reviews and high technology readiness, are fundamental to containing cost growth. However, DOD continues to disagree with our long-established best practice standard for technology maturity. Our assessment notes the difference between our criteria and the standard for technology maturity contained in statute, while also acknowledging the significant increase in the technology maturity of newer programs entering system development. We also received technical comments from DOD, which have been addressed in the report, as appropriate.

We are sending copies of this report to the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; and the Director of the Office of Management and Budget. In addition, the report will be made available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff have any questions concerning this report, please contact me at (202) 512-4841. Contact points for our offices of Congressional Relations and Public Affairs may be found on the last page of this report. Staff members making key contributions to this report are listed in appendix IV.

Michael J. Sullivan
Director, Acquisition and Sourcing Management

List of Committees

The Honorable Carl Levin
Chairman
The Honorable John McCain
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Daniel Inouye
Chairman
The Honorable Thad Cochran
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Ike Skelton
Chairman
The Honorable Howard P. McKeon
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Norman D. Dicks
Chairman
The Honorable C.W. Bill Young
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Scope and Methodology

This report contains observations on the Department of Defense's (DOD) efforts to manage its fiscal year 2009 major defense acquisition program portfolio. To develop these observations, we obtained and analyzed documentation related to DOD's fiscal year 2010 budget request, focusing on the Secretary of Defense's recommendations to cancel or curtail a number of weapon programs. Using data and information obtained from individual programs, we evaluated the effect of the Secretary of Defense's recommendations and identified future plans and requirements related to the cancelled programs.

We also collected and analyzed data on the composition of DOD's major defense acquisition program portfolio. To determine changes in that portfolio, we compared DOD's fiscal year 2009 major defense acquisition programs list, dated June 2009, with the list of programs that issued Selected Acquisition Reports in December 2007. To assess the cost effect of changes to the major defense acquisition portfolio, we first calculated the estimated total cost of the 18 programs entering the portfolio using data from program documents, specifically acquisition program baselines. We did not obtain cost data on 5 of the 18 programs because they did not have an approved acquisition program baseline, so this amount is understated. To calculate the estimated total cost of the 12 programs exiting the portfolio, we used current cost estimates from December 2007 Selected Acquisition Reports. We also calculated the total cost growth attributable to these programs by comparing their first full estimates to the current estimate in December 2007 Selected Acquisition Reports. We excluded the Army's Future Combat System from our analysis of the portfolio changes since it appeared on DOD's fiscal year 2009 major defense acquisition program list, despite its June 2009 termination. However, because of its significance, we included its total estimated cost and cost growth since its first estimate in our discussion. The net cost effect of the Future Combat System termination is unknown since the Army plans to start several new programs to deliver some of the same or similar capabilities.

Our ability to analyze the overall cost and schedule performance of DOD's fiscal year 2009 major defense acquisition program portfolio was limited because DOD did not prepare timely Selected Acquisition Reports that reflected the Secretary of Defense's proposed changes to weapon programs in the fiscal year 2010 budget. DOD did not provide another source of reliable data for us to use for this analysis. DOD prepared limited Selected Acquisition Reports for 85 of 102 major defense acquisition programs by November 2009, 6 months after the budget was submitted. Four programs prepared a baseline Selected Acquisition Report or a Selected Acquisition

Report following a breach of the applicable statutory threshold—commonly referred to as a Nunn-McCurdy unit cost breach;[1] one program was designated a major acquisition information system program; and 12 programs that were either new major defense acquisition programs or programs that were being restructed did not prepare any Selected Acquisition Reports. The data in the limited Selected Acquisition Reports were not complete. Program costs were not updated from December 2007 Selected Acquisition Reports, except to reflect changes in the funding received in fiscal year 2009 and funding requested in fiscal year 2010. According to DOD, the rest of the cost data on programs could not be updated because the fiscal year 2011–2015 Future Years Defense Program was not complete. As a result, the limited Selected Acquisition Reports were not suitable for an overall analysis of the cost and schedule performance of DOD's fiscal year 2009 major defense acquisition program portfolio.

With the exception of the budget dollars reported in table 1, all cost data in this report are in fiscal year 2010 dollars. We converted cost information to fiscal year 2010 dollars using conversion factors from the DOD Comptroller's National Defense Budget Estimates for Fiscal Year 2010 (Table 5-9). Through discussions with DOD officials responsible for this data and confirming selected data with program offices we determined that the data and information were sufficiently reliable for our purposes.

Analysis of Selected DOD Programs Using Knowledge-Based Criteria

In total, this report presents information on 70 weapon programs. A table listing these programs is found in appendix IV. Out of these programs, 57 programs are captured in a two-page format discussing technology, design, and manufacturing knowledge obtained and other program issues. The remaining 13 programs are described in a one-page format that describes their current status. We chose these programs based on their estimated cost, stage in the acquisition process, and congressional interest. To obtain cost, schedule, technology, design, and manufacturing information from the programs, as well as information on other program factors such as requirements changes, configuration steering board activities, software development, and program office staffing, we asked 57 programs to complete two data collection instruments. We received responses from all 57 programs to the cost, schedule, and technology, design, and

[1] 10 U.S.C. § 2433.

manufacturing instrument and responses from 56 programs to the data collection instrument related to other program factors.

Our analysis of how well programs are adhering to a knowledge-based acquisition approach focuses on a subset of 42 nonshipbuilding major defense acquisition programs from DOD's fiscal year 2009 portfolio that are primarily in development or the early stages of production. The 28 programs that are not included in this analysis either do not have acquisition milestones that line up with development start, critical design review, and production start or lack key data on technology, design, and production necessary to assess them against our knowledge-based acquisition criteria at this point in time.[2]

To assess knowledge attainment of programs at critical decision points (system development start, critical design review, and production start), we collected data about their knowledge levels at each point. The data were collected from 42 program offices as of January 2010 (additional information on product knowledge is found in the product knowledge assessment section of this appendix). Programs in our assessment were in various stages of the acquisition cycle, and not all of the programs provided knowledge information for each point. Programs were not included in our assessments if relevant decision or knowledge point data were not available. For each decision point, we summarized knowledge attainment as the number of programs with data that achieved that knowledge point. Twenty-nine programs provided data on technology maturity at development start, 28 programs provided data on design stability at their critical design review, and 7 programs provided data on production processes in control at production start. Our analysis of knowledge attained at each key point also includes other factors that we have previously identified as being key to a knowledge-based acquisition approach, including holding systems design reviews early in development, testing an integrated prototype prior to the design review, and testing a production representative prototype prior to making a production decision.

[2]The 28 programs in our assessment that are not covered in this analysis include: 10 pre-major defense acquisition programs, 6 Missile Defense Agency elements, 5 shipbuilding major defense acquisition programs, 3 components or subprograms within major defense acquisition programs, 2 programs that have been terminated or are ending, 1 major defense acquisition program that is based on a commercially-derived aircraft, and 1 acquisition category II program. An acquisition category II program is defined as a program that does not meet the criteria for an acquisition category I program and is estimated to require eventual total RDT&E expenditures of more than $140 million or procurement expenditures of more than $660 million in fiscal year 2000 constant dollars.

We did not validate the data provided by the program offices, but reviewed the data and performed various checks to determine that they were reliable enough for our purposes. Where we discovered discrepancies, we clarified the data accordingly. In all but one of these areas, our potential group of respondents includes 46 major defense acquisition programs, including ships. The number of programs that responded to each of our questions varies. For our analysis of requirements changes, we obtained and analyzed information from 42 programs about the number and effect of requirements changes since development start. For our analysis of software development, we obtained and analyzed information from 42 programs related to the number of software lines of code expected in the final system at development start and currently, and the percentages of software defects contained in-phase and in subsequent phases. Finally, we analyzed information related to program office staffing from 50 programs, including 46 major defense acquisition programs and 4 Missile Defense Agency elements, on the number of military personnel, civilian government employees, support contractors, and Federally Funded Research and Development Centers and university-affiliated employees working in the following functions: program management, business related functions, contracting, engineering and technical support, administrative support, and other functions.

To determine how DOD has begun to implement acquisition reform, we obtained and analyzed the revised DOD 5000.02 acquisition instruction and the Weapon Systems Acquisition Reform Act of 2009. We also analyzed the pre-major defense acquisition programs in our assessment to determine how they were implementing requirements for competitive prototyping and preliminary design reviews. We also analyzed questionnaire responses from 45 programs on configuration steering boards.

Finally, we relied on GAO's body of work examining DOD acquisition issues over the years. In recent years, we have issued reports that have identified systemic problems with major weapon systems acquisitions and we have made recommendations to DOD on ways to improve how it acquires major weapon systems. These reports cover contracting, program management, acquisition policy, cost estimating, budgeting, and requirements development. We have also issued many detailed reports evaluating specific weapon systems, such as aircraft programs, ships, communication systems, satellites, missile defense systems, and future combat systems. Finally, we used information from numerous GAO products that examine how commercial best practices can improve outcomes for DOD programs. This work has shown that valuable lessons

can be learned from the commercial sector and can be applied to the development of weapon systems.

System Profile Data on Each Individual Two-Page Assessment

Over the past several years, DOD has revised policies governing weapon system acquisitions and changed the terminology used for major acquisition events. To make DOD's acquisition terminology more consistent across the 70 program assessments, we standardized the terminology for key program events. For most individual programs in our assessment, "development start" refers to the initiation of an acquisition program as well as the start of engineering and manufacturing development. This coincides with DOD's Milestone B. A few programs in our assessment (mostly programs that began before 2001) have a separate "program start" date, which begins a pre-system development phase for program definition and risk reduction activities. This "program start" date generally coincides with DOD's old terminology for Milestone I, followed by a "development start" date, either DOD's old Milestone II or new Milestone B depending on when the program began system development. The "production decision" generally refers to the decision to enter the production and deployment phase, typically with low-rate initial production. The "initial capability" refers to the initial operational capability—sometimes called first unit equipped or required asset availability. For shipbuilding programs, the schedule of key program events in relation to acquisition milestones varies for each program. Our work on shipbuilding best practices has identified the detailed design and construction contract award and the start of lead ship fabrication as the points in the acquisition process roughly equivalent to development start and design review for other programs. For MDA programs that do not follow the standard DOD acquisition model but instead develop systems' capabilities incrementally, we identify the key technology development efforts that lead to an initial capability.

For each program we assessed in a two-page format, we present cost, schedule and quantity data at the program's first full estimate, generally Milestone B, and an estimate from the program office reflecting 2009 data where it was available. Since DOD did not produce Selected Acquisition Reports for 2009, changes in cost, quantities, and cycle time are based on data obtained from program offices prepared in accordance with directions from DOD. According to those directions, program cost data are based on information contained in the December 2007 Selected Acquisition Reports adjusted to reflect funding appropriated in fiscal year 2009 and funding requested in fiscal year 2010. Where necessary, we resolved discrepancies in this data with program offices to ensure its reliability. If current data

were not available we show that the data were not assessed or are to be determined. For systems that have not yet started system development, we provided funding through the future years defense program. For MDA systems, for which a baseline was not available, we do not present a comparison.

For each program we assessed, all cost information is presented in fiscal year 2010 dollars using Office of the Secretary of Defense-approved deflators to eliminate the effects of inflation. We have depicted only the program's main elements of acquisition cost—research and development and procurement. However, the total programs cost also include military construction and acquisition operation and maintenance costs. Because of rounding and these additional costs, in some situations, total cost may not match the exact sum of the research and development and procurement costs. The program unit costs are calculated by dividing the total program cost by the total quantities planned. In some instances, the data were not applicable, and we annotate this by using the term "NA." The quantities listed refer to total quantities, including both procurement and development quantities.

The schedule assessment for each program is based on acquisition cycle time, defined as the number of months between program start and the achievement of initial operational capability or an equivalent fielding date. In some instances the data were not yet available, and we annotate this by using the term "TBD" or noting that the information is classified.

The information presented on the "funding needed to complete" is from fiscal year 2010 through completion and, unless otherwise noted, draws on information from the program office. In some instances, the data were not available, and we annotate this by the term "to be determined" (TBD) or "not applicable" (NA). The quantities listed refer only to procurement quantities. Satellite programs, in particular, produce a large percentage of their total operations units as development quantities, which are not included in the quantity figure.

The intent of these comparisons is to provide an aggregate, or overall, picture of a program's history. These assessments represent the sum of the federal government's actions on a program not just those of the program manager and the contractor. DOD does a number of detailed analyses of changes that attempt to link specific changes with triggering events or causes. Our analysis does not attempt to make such detailed distinctions.

Product Knowledge Data on Individual Two-Page Assessments

To assess the product development knowledge of each program at key points in development, we submitted a data collection instrument to 57 program offices. We received responses from all 57 programs; however, not every program had responses to each element of the data collection instrument. The results are graphically depicted in each two-page assessment. We also reviewed pertinent program documentation and discussed the information presented on the data collection instrument with program officials as necessary.

To assess technology maturity, we asked program officials to apply a tool, referred to as Technology Readiness Levels (TRL), for our analysis. The National Aeronautics and Space Administration originally developed TRLs, and the Army and Air Force science and technology research organizations use them to determine when technologies are ready to be handed off from science and technology managers to product developers. TRLs are measured on a scale from 1 to 9, beginning with paper studies of a technology's feasibility and culminating with a technology fully integrated into a completed product. (See app. III for TRL definitions.) Our best practices work has shown that a technology readiness level of 7—demonstration of a technology in a realistic environment—is the level of technology maturity that constitutes a low risk for starting a product development program. For shipbuilding programs, we have recommended that this level of maturity be achieved by the contract award for detailed design and construction. In our assessment, the technologies that have reached TRL 7, a prototype demonstrated in a realistic environment, are referred to as mature or fully mature. Those technologies that have reached TRL 6, a prototype demonstrated in a relevant environment, are referred to as approaching or nearing maturity and are assessed at attaining 50 percent of the desired level of knowledge. Satellite technologies that have achieved TRL 6 are assessed as fully mature due to the difficulty of demonstrating maturity in a realistic environment—space.

In most cases, we did not validate the program offices' selection of critical technologies or the determination of the demonstrated level of maturity. We sought to clarify the TRLs in those cases where information existed that raised concerns. If we were to conduct a detailed review, we might adjust the critical technologies assessed, their readiness levels demonstrated, or both. It was not always possible to reconstruct the technological maturity of a weapon system at key decision points after the passage of many years. Where practicable, we compared technology assessments provided by the

program office to assessments conducted by officials from the Office of the Director, Defense Research and Engineering.

To assess design stability, we asked program officials to provide the percentage of engineering drawings completed or projected for completion by the design review, the production decision, and as of our current assessment. In most cases, we did not verify or validate the percentage of engineering drawings provided by the program office. We clarified the percentage of drawings completed in those cases where information that raised concerns existed. Completed drawings were defined as the number of drawings released or deemed releasable to manufacturing that can be considered the "build to" drawings. For shipbuilding programs, we asked programs officials to provide the percentage of the 3D product model that had been completed by the start of lead ship fabrication, and as of our current assessment.

To assess production maturity, we asked program officials to identify the number of critical manufacturing processes and, where available, to quantify the extent of statistical control achieved for those processes. In most cases, we did not verify or validate the information provided by the program office. We clarified the number of critical manufacturing processes and the percentage of statistical process control where information existed that raised concerns. We used a standard called the Process Capability Index, a process performance measurement that quantifies how closely a process is running to its specification limits. The index can be translated into an expected product defect rate, and we have found it to be a best practice. We sought other data, such as scrap and rework trends, in those cases where quantifiable statistical control data were unavailable. We do not assess production maturity for shipbuilding programs.

Although the knowledge points provide excellent indicators of potential risks, by themselves they do not cover all elements of risk that a program encounters during development, such as funding instability. Our detailed reviews on individual systems normally provide a more comprehensive assessment of risk elements.

We conducted this performance audit from August 2009 to March 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence

obtained provides a reasonable basis for our findings based on our audit objectives.

Comments from the Department of Defense

Note: Page numbers in the draft report may differ from those in this report.

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Sullivan:

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-10-388SP, "DEFENSE ACQUISITIONS: Assessments of Selected Weapon Programs," dated February 17, 2010 (GAO Code 120830).

The Department is encouraged that the draft report cites the progress that we have made over the past several years in our efforts to improve acquisition processes and reduce cost growth. We have instituted several major changes that are beginning to show results. As noted in the draft report, recent acquisition policy revisions and the Weapon Systems Acquisition Reform Act (WSARA) of 2009 are aimed at starting programs out right by using early systems engineering, competitive prototyping, and configuration steering boards. The draft report acknowledges that there has been continued improvement in the technology, design, and manufacturing knowledge that programs had at key points in the acquisition process. We agree that early systems engineering reviews and increasing technology readiness levels for new programs will be fundamental to restraining cost growth across the major defense acquisition programs. The Department is moving forward to implement WSARA and we expect to see even more improvement in the years to come. The draft report also acknowledges that recent changes in DoD acquisition policies are having beneficial impacts with respect to requirements changes, software development challenges, and workforce issues. In addition, we will be growing and improving the acquisition workforce to increase our capacity and capability to manage program cost, schedule, and performance.

DoD and GAO, however, continue to disagree on the meaning of "mature technology" before launching into system development. For GAO, that term means Technology Readiness Level (TRL) 7. For DoD, it means TRL 6. Thus, throughout the draft report, there are frequent references to immature technology being used in Major Defense Acquisition Program (MDAP) system development, which is often true if a threshold of TRL 7 is applied. On page 15, for example, GAO says that only one of six

MDAPs that entered system development since 2006 had mature critical technologies. That may be true when using GAO's definition, but DoD has taken the position that TRL 6 is adequate at Milestone B (which is considered the start of system development). Therefore, it's misleading for GAO to say repeatedly that MDAPs are not using mature technology. It would be more fair and accurate to say that MDAPs are sometimes using TRL 6, but not TRL 7, critical technologies when starting system development.

I thank you and your staff for working with the Department to improve the information flow between our organizations and to develop more meaningful metrics in this area. I hope the new metrics that our staffs developed together last year will be included in future reports. These metrics will allow for a more accurate assessment of current portfolio performance and policies. We must continue to improve the acquisition process to more effectively and efficiently deliver products to our customers, and we need to continue to develop better metrics. The Department looks forward to working with the GAO in both important endeavors.

The Department appreciates the opportunity to comment on the draft report. Technical comments are provided as an enclosure to this letter. My point of contact for this effort is Ms. Anne Twist, 703-614-5420.

Sincerely,

Nancy L. Spruill

Dr. Nancy L. Spruill
Director,
Acquisition Resources & Analysis

Enclosure:
As stated

2

Technology Readiness Levels

Technology readiness level	Description	Hardware/software	Demonstration environment
1. Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties	None (paper studies and analysis)	None
2. Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.	None (paper studies and analysis)	None
3. Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Analytical studies and demonstration of nonscale individual components (pieces of subsystem)	Lab
4. Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.	Low-fidelity breadboard. Integration of nonscale components to show pieces will work together. Not fully functional or form or fit but representative of technically feasible approach suitable for flight articles.	Lab
5. Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	High-fidelity breadboard. Functionally equivalent but not necessarily form and/or fit (size weight, materials, etc). Should be approaching appropriate scale. May include integration of several components with reasonably realistic support elements/subsystems to demonstrate functionality.	Lab demonstrating functionality but not form and fit. May include flight demonstrating breadboard in surrogate aircraft. Technology ready for detailed design studies.
6. System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated realistic environment.	Prototype. Should be very close to form, fit and function. Probably includes the integration of many new components and realistic supporting elements/subsystems if needed to demonstrate full functionality of the subsystem.	High-fidelity lab demonstration or limited/restricted flight demonstration for a relevant environment. Integration of technology is well defined.

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Technology readiness level	Description	Hardware/software	Demonstration environment
7. System prototype demonstration in a realistic environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in a realistic environment, such as in an aircraft, vehicle or space. Examples include testing the prototype in a test bed aircraft.	Prototype. Should be form, fit and function integrated with other key supporting elements/subsystems to demonstrate full functionality of subsystem.	Flight demonstration in representative realistic environment such as flying test bed or demonstrator aircraft. Technology is well substantiated with test data.
8. Actual system completed and "flight qualified" through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	Flight-qualified hardware	Developmental Test and Evaluation (DT&E) in the actual system application.
9. Actual system "flight proven" through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.	Actual system in final form	Operational Test and Evaluation (OT&E) in operational mission conditions.

Source: GAO and its analysis of National Aeronautics and Space Administration data.

GAO Contact and Acknowledgments

GAO Contact

Michael J. Sullivan, (202) 512-4841 or sullivanm@gao.gov

Acknowledgments

Principal contributors to this report were Ronald E. Schwenn, Assistant Director; Raj Chitikila; Carol T. Mebane; Wendy P. Smythe; and Barbara J. Williams. Other key contributors included David B. Best, Maricela Cherveny, Thomas J. Denomme, Bruce D. Fairbairn, Arthur Gallegos, William R. Graveline, Kristine R. Hassinger, Michael J. Hesse, Arthur L. James, Jr., Meredith A. Kimmett, Jean L. McSween, John E. Oppenheim, Kenneth E. Patton, Guisseli Reyes-Turnell, Rae Ann H. Sapp, Robert S. Swierczek, Bruce H. Thomas, Molly W. Traci, and Karen S. Zuckerstein.

The following were responsible for individual programs:

System	Primary staff
Advanced Extreme High Frequency Satellites (AEHF)	Bradley Terry
AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)	Kathryn M. Edelman, Shea Bader
Air and Missile Defense Radar (AMDR)	Molly W. Traci, Matthew C. Butler
Airborne Signals Intelligence Payload Baseline (ASIP)	Laura Jezewski, Travis J. Masters
B-2 Spirit Advanced Extremely High Frequency SatCom Capability (B-2 EHF SATCOM) Increment 1	Sean D. Merrill, Don M. Springman
B-2 Spirit Advanced Extremely High Frequency SatCom Capability (B-2 EHF SATCOM) Increment 2	Sean D. Merrill, Don M. Springman
BMDS: Aegis Ballistic Missile Defense (Aegis BMD)	Wiktor Niewiadomski, Thomas A. Mahalek
BMDS: Airborne Laser (ABL)	LaTonya D. Miller
BMDS: Flexible Target Family (FTF)	Ivy G. Hubler, Steven B. Stern
BMDS: Ground-Based Midcourse Defense (GMD)	Steven B. Stern
BMDS: Space Tracking and Surveillance System (STSS)	Wiktor Niewiadomski, Sigrid L. McGinty
BMDS: Terminal High Altitude Area Defense (THAAD)	Meredith A. Kimmett
Broad Area Maritime Surveillance Unmanned Aircraft System (BAMS UAS)	W. William Russell, Jennifer A. Dougherty

(Continued From Previous Page)

System	Primary staff
C-130 Avionics Modernization Program (C-130 AMP)	Lauren M. Heft, Dayna L. Foster
C-5 Reliability Enhancement and Reengining Program (C-5 RERP)	Cheryl K. Andrew, Marvin E. Bonner
CH-53K Heavy Lift Replacement (HLR)	Kevin J Heinz, Laurier R. Fish
Common Infrared Countermeasures (CIRCM)	Danny G. Owens
CVN 21 Nuclear Aircraft Class Carrier	Molly W. Traci, Thomas P. Twambly, W. Kendal Roberts
DDG 1000 Destroyer	Michelle M. Liberatore, Raj Chitikila
E-2D Advanced Hawkeye (E-2D AHE)	Jeffrey L. Hartnett, David Messman
EA-18G Growler	Jerry W. Clark, Bonita P. Oden
Expeditionary Fighting Vehicle (EFV)	Nicholas C. Alexander, Jenny Hwang
Excalibur Precision Guided Extended Range Artillery Projectile	Beverly A. Breen
Extended Range/Multiple Purpose Unmanned Aircraft System (ER / MP)	Tana M. Davis
F-22A Raptor	Marvin E. Bonner, Robert K. Miller
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	Alexandra K. Dew, Scott Purdy
Future Combat System (FCS)	Marcus C. Ferguson, William C. Allbritton
Future Combat System Spin Out Early-Infantry Brigade Combat Team (FCS SO E-IBCT)	Marcus C. Ferguson, Tana M. Davis
Global Hawk Unmanned Aircraft system	Charlie Shivers, J. Andrew Walker
Global Positioning Systems Block IIIA	Laura T. Holliday, Josie H. Sigl
Global Positioning Systems III Next Generation Ground Control Segment (GPS III OCX)	Arturo Holguin, Jr.
H-1 Upgrades	Stephen V. Marchesani, Brenna Guarneros
Joint Air-to-Ground Missile (JAGM)	Tana M. Davis, Carrie W. Rogers
Joint Air-to-Surface Standoff Missile (JASSM)	Willliam C. Allbritton, Michael J. Hesse
C-27J Spartan	Andrew H. Redd, Brian T. Smith
Joint High Speed Vessel (JHSV)	Michelle M. Liberatore, J. Kristopher Keener
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	John M. Ortiz
Joint Light Tactical Vehicle (JLTV)	Carrie W. Rogers, Dayna L. Foster
Joint Precision Approach and Landing System (JPALS)	Lindsay Taylor, Ridge C. Bowman
Joint Strike Fighter (JSF)	David M. Adams, Ridge C. Bowman

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System	Primary staff
Joint Tactical Radio System Airborne, Maritime, Fixed-Station (JTRS AMF)	Paul G. Williams, Guisseli Reyes-Turnell
Joint Tactical Radio System Ground Mobile Radio (JTRS GMR)	Ann Marie Udale
Joint Tactical Radio System Handheld, Manpack, Small Form Fit (JTRS HMS)	Guisseli Reyes-Turnell, Ann Marie Udale
Joint Tactical Radio System Network Enterprise Domain (JTRS NED)	James S. Kim, James P. Tallon
Kiowa Warrior Cockpit and Sensor Upgrade Program (KW CASUP)	Wendy P. Smythe, Michael J. Hesse
LHA 6 Amphibious Assault Ship Replacement Program (LHA 6)	Barbara J. Williams, Raj Chitikila
Littoral Combat Ship (LCS)	Julia P. Jebo, Christopher R. Durbin
Littoral Combat Ship: Mission Modules (LCS Modules)	Jeremy Hawk, Christopher R. Durbin
Longbow Apache Block III (AB3)	Helena Brink, Wendy P. Smythe
Maritime Prepositioning Force (Future)/Mobile Landing Platform (MPF(F)/MLP)	J. Kristopher Keener, Kelly Bradley
Mine Resistant Ambush Protected Vehicle (MRAP)	Dayna L. Foster, Erin L. Stockdale
Mobile User Objective System (MUOS)	Richard Y. Horiuchi
MQ-9 Reaper Unmanned Aircraft System	Rae Ann Sapp
Multifunctional Information Distribution System-Joint Tactical Radio System (MIDS JTRS)	Raffaele Roffo, Leigh Ann Nally
National Polar-orbiting Operational Environment Satellite System (NPOESS)	Suzanne Sterling, Angela M. Pleasants
NAVSTAR Global Positioning System (GPS) Space and Control	Laura T. Holliday, Josie H. Sigl
Navy Multiband Terminal (NMT)	Lisa P. Gardner
Ohio-Class Replacement/Sea Based Strategic Deterrent (SBSD)	C. James Madar, Matthew C. Butler
P-8A Poseidon (P-8A)	Kathryn M. Edelman
Patriot/MEADS Combined Aggregate Program (CAP) Fire Unit	Ryan D. Stott, Carol T. Mebane
Small Diameter Bomb, Increment II (SDB II)	Michael J. Hesse
Space Based Infrared System (SBIRS) High	Claire Buck
Space-Based Surveillance Block 10 (SBSS)	Maricela Cherveny
Standard Missile-6 Extended Range Active Missile (SM-6)	Wiktor Neiwiadomski, Thomas A. Mahalek

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System	Primary staff
Third Generation Infrared Surveillance (3GIRS)	Laura T. Holliday
V-22 Joint Services Advanced Vertical Lift Aircraft	Bonita P. Oden, Jerry W. Clark
Vertical Take-off and Landing Tactical Unmanned Aerial Vehicle (VTUAV Fire Scout)	Leigh Ann Nally, Raffaele Roffo
Virginia-Class Submarine (SSN 774)	C. James Madar, Matthew C. Butler
Warfighter Information Network-Tactical Increment 2	James P. Tallon
Warfighter Information Network-Tactical Increment 3	James P. Tallon

Source: GAO.

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